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(54) **EXPLOSIVE WELL TOOL FIRING HEAD**

application No. 10/762,182, filed on Jan. 21, 2004, now Pat. No. 7,530,397, which is a continuation of application No. 09/949,990, filed on Sep. 10, 2001, now abandoned.

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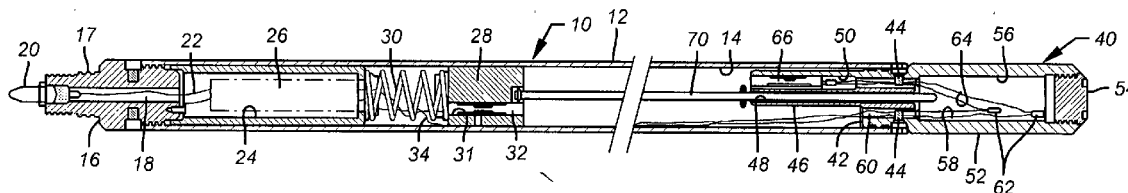
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E21B 29/02 (2006.01)
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USPC **166/378**

Related U.S. Application Data

(60) Continuation of application No. 13/573,530, filed on Sep. 24, 2012, now Pat. No. 8,770,301, which is a division of application No. 13/317,657, filed on Oct. 25, 2011, now Pat. No. 8,302,523, which is a continuation of application No. 12/798,269, filed on Apr. 1, 2010, now Pat. No. 8,136,439, which is a continuation-in-part of application No. 11/442,807, filed on May 30, 2006, now Pat. No. 7,698,982, which is a division of

(57) **ABSTRACT**

A firing head embodiment of the invention confines a connected capacitance cartridge, explosive detonator, and wire-line connection switch within an independent, cylindrical housing tube that is environmentally capped at both ends by threaded closures for secure transport to a well site.



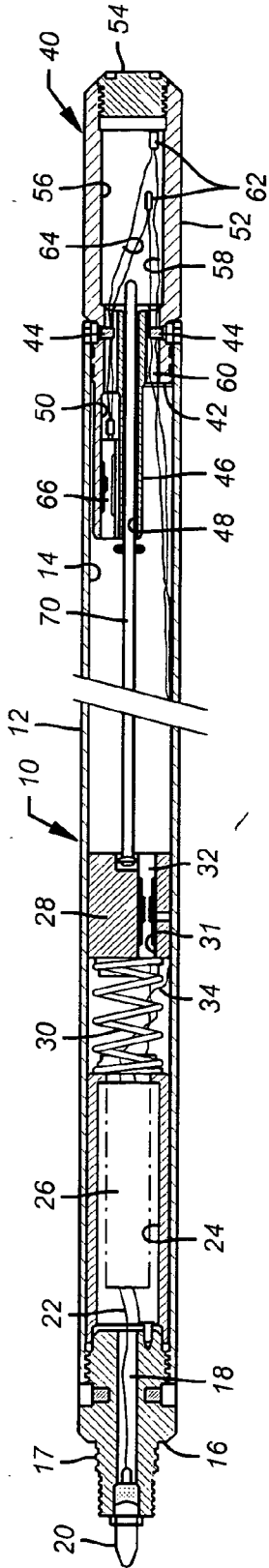


FIG. 1

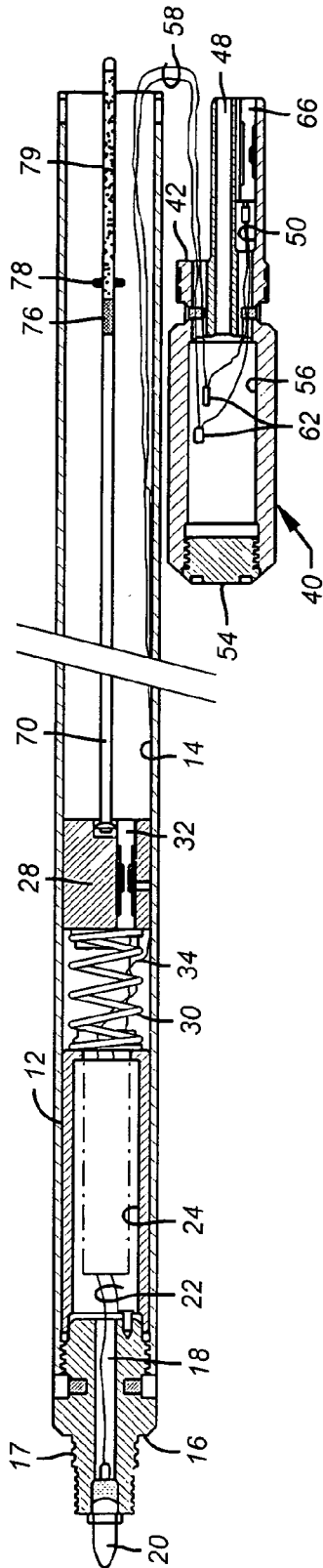


FIG. 2

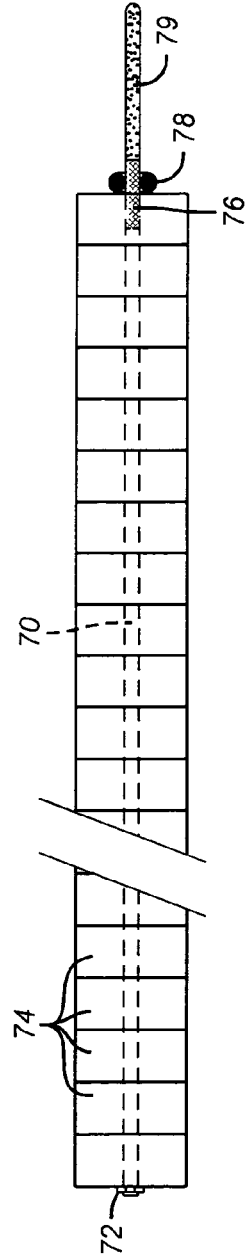


FIG. 3

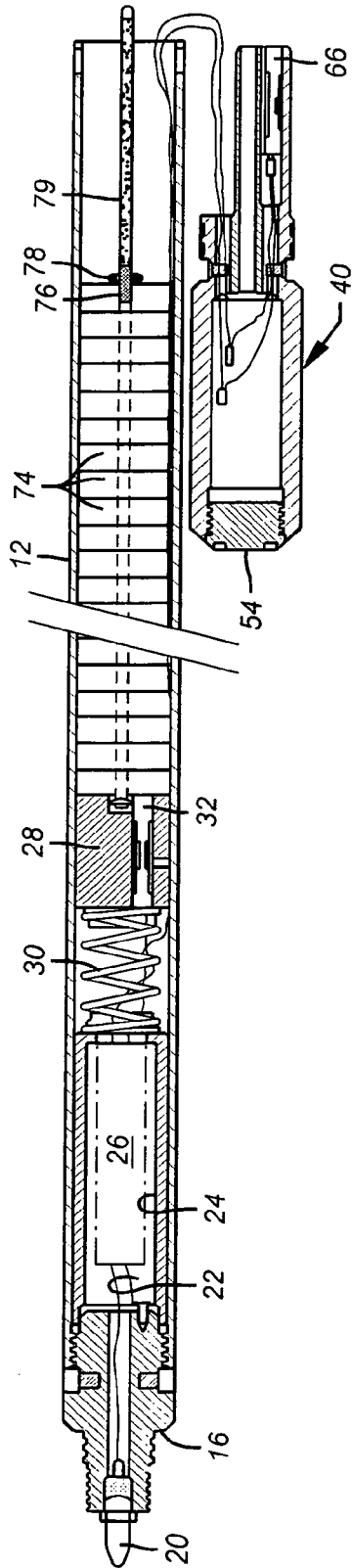


FIG. 4

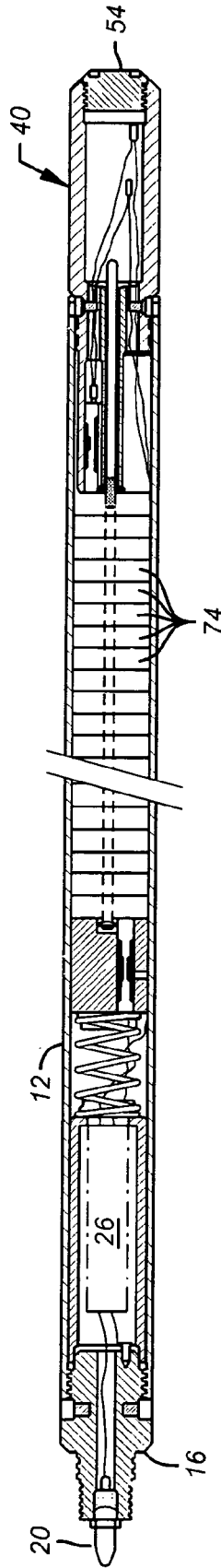


FIG. 5

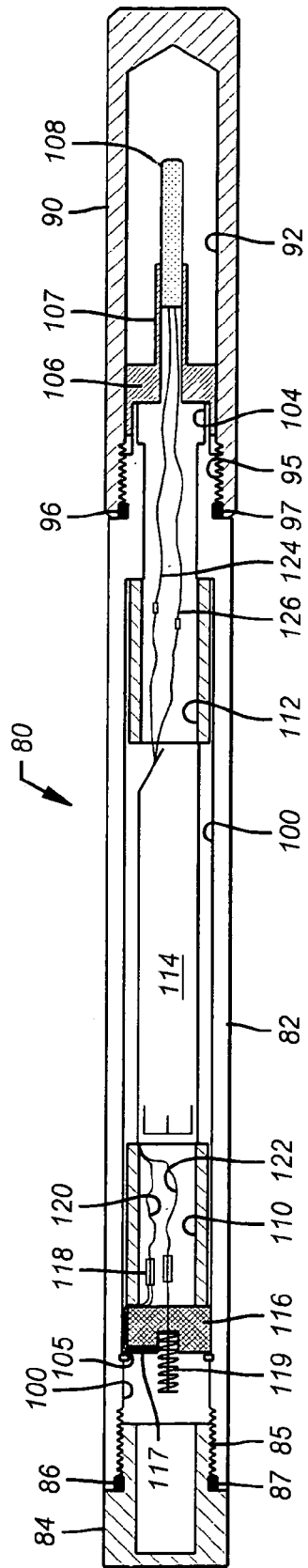


FIG. 6

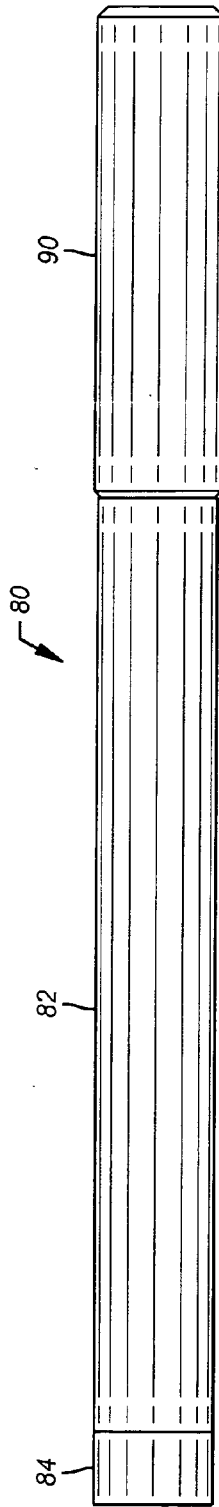


FIG. 7

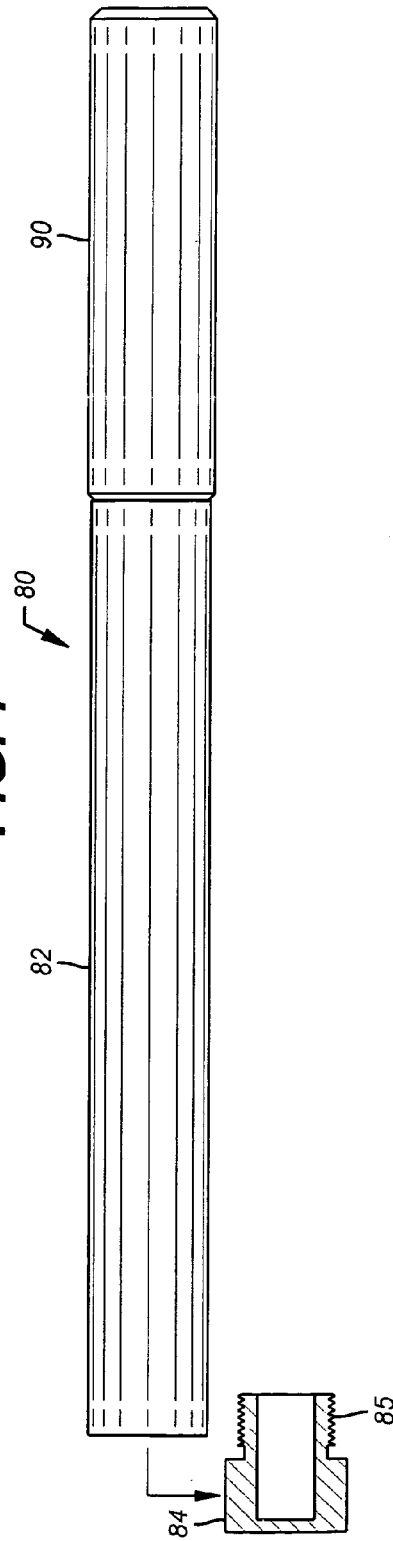


FIG. 8

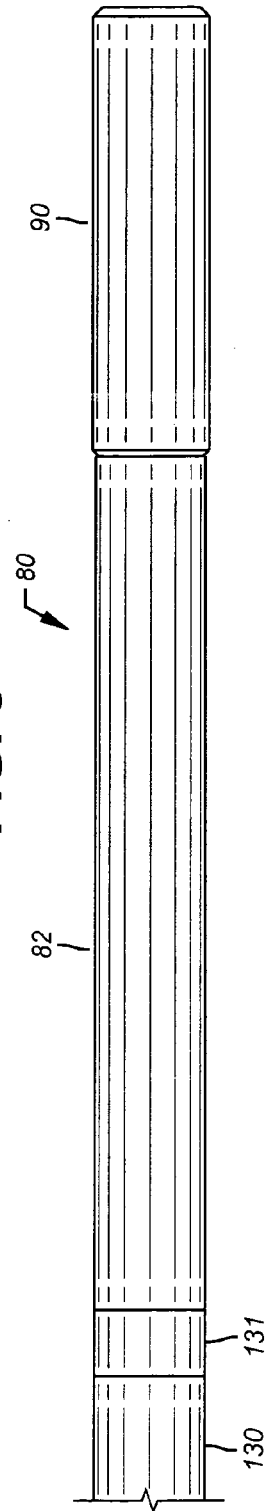


FIG. 9

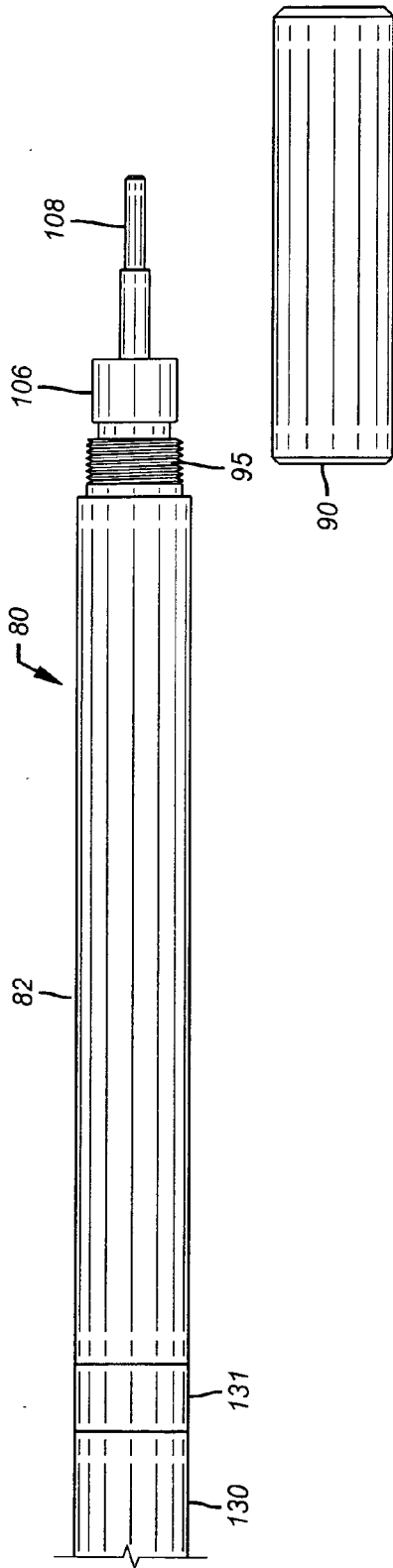


FIG. 10

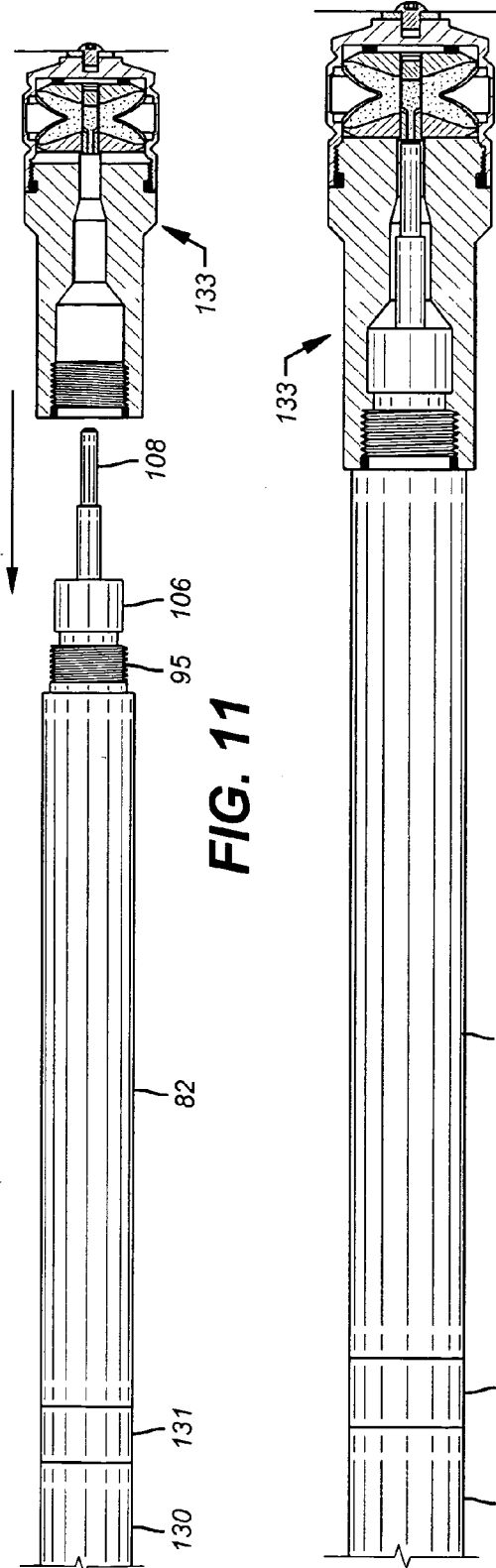


FIG. 11

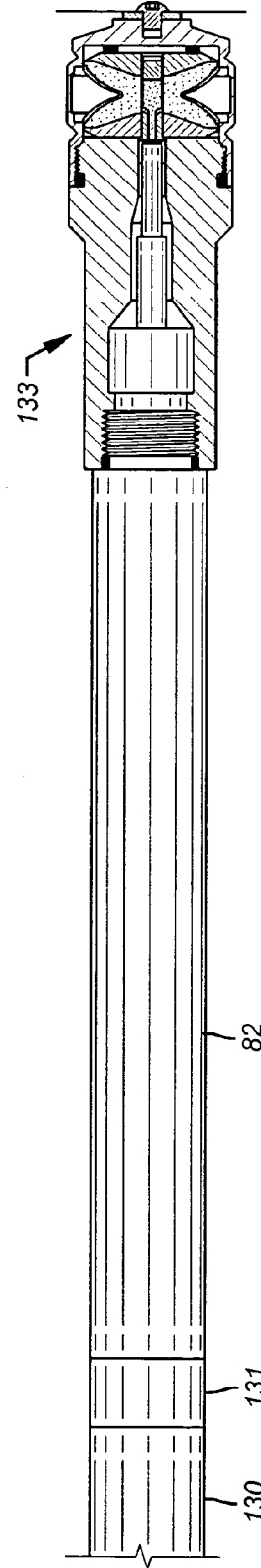


FIG. 12

EXPLOSIVE WELL TOOL FIRING HEAD

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a Continuation of presently pending application Ser. No. 13/573,530 filed Sep. 24, 2012. Said application Ser. No. 13/573,530 is a Division of U.S. patent application Ser. No. 13/317,657, filed Oct. 25, 2011, now U.S. Pat. No. 8,302,523 Issued Nov. 6, 2012. Said U.S. Pat. No. 8,302,523 is a Continuation of U.S. patent application Ser. No. 12/798,269, filed Apr. 1, 2010, now U.S. Pat. No. 8,136,439, which is a Continuation-In-Part of U.S. patent application Ser. No. 11/442,807, filed May 30, 2006, now U.S. Pat. No. 7,698,982, which is Division of U.S. patent application Ser. No. 10/762,182, filed Jan. 21, 2004, now U.S. Pat. No. 7,530,397, which is Continuation of U.S. patent application Ser. No. 09/949,990, filed Sep. 10, 2001 and now abandoned, and which all are incorporated herein in their entireties by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

BACKGROUND OF THE INVENTION

[0003] 1. Field of the Invention

[0004] The present invention relates to the earthboring arts. More particularly, the invention relates to methods and devices for severing drill pipe, casing and other massive tubular structures by the remote detonation of an explosive cutting charge.

[0005] 2. Description of Related Art

[0006] Deep well earthboring for gas, crude petroleum, minerals and even water or steam requires tubes of massive size and wall thickness. Tubular drill strings may be suspended into a borehole that penetrates the earth's crust several miles beneath the drilling platform at the earth's surface. To further complicate matters, the borehole may be turned to a more horizontal course to follow a stratification plane.

[0007] The operational circumstances of such industrial enterprise occasionally presents a driller with a catastrophe that requires him to sever his pipe string at a point deep within the wellbore. For example, a great length of wellbore sidewall may collapse against the drill string causing it to wedge tightly in the well bore. The drill string cannot be pulled from the well bore and in many cases, cannot even be rotated. A typical response for salvaging the borehole investment is to sever the drill string above the obstruction, withdraw the freed drill string above the obstruction and return with a "fishing" tool to free and remove the wedged portion of drill string.

[0008] When an operational event such as a "stuck" drill string occurs, the driller may use wireline suspended instrumentation that is lowered within the central, drill pipe flow bore to locate and measure the depth position of the obstruction. This information may be used to thereafter position an explosive severing tool within the drill pipe flow bore.

[0009] Typically, an explosive drill pipe severing tool comprises a significant quantity, 800 to 1,500 grams for example, of high order explosive such as RDX, HMX or HNS. The explosive powder is compacted into high density "pellets" of about 22.7 to about 38 grams each. The pellet density is compacted to about 1.6 to about 1.65 gms/cm³ to achieve a shock wave velocity greater than about 30,000 ft/sec, for

example. A shock wave of such magnitude provides a pulse of pressure in the order of 4×10^6 psi. It is the pressure pulse that severs the pipe.

[0010] In one form, the pellets are compacted at a production facility into a cylindrical shape for serial, juxtaposed loading at the jobsite as a column in a cylindrical barrel of a tool cartridge. Due to weight variations within an acceptable range of tolerance between individual pellets, the axial length of explosive pellets fluctuates within a known tolerance range. Furthermore, the diameter-to-axial length ratio of the pellets is such that allows some pellets to wedge in the tool cartridge barrel when loaded. For this reason, a go-no-go type of plug gauge is used by the prior art at the end of a barrel to verify the number of pellets in the tool barrel. In the frequent event that the tool must be disarmed, the pellets may also wedge in the barrel upon removal. A non-sparking depth-rod is inserted down the tool barrel to verify removal of all pellets.

[0011] Extreme well depth is often accompanied by extreme hydrostatic pressure. Hence, the drill string severing operation may need to be executed at 10,000 to 20,000 psi. Such high hydrostatic pressures tend to attenuate and suppress the pressure of an explosive pulse to such degree as to prevent separation.

[0012] One prior effort by the industry to enhance the pipe severing pressure pulse and overcome high hydrostatic pressure suppression has been to detonate the explosive pellet column at both ends simultaneously. Theoretically, simultaneous detonations at opposite ends of the pellet column will provide a shock front from one end colliding with the shock front from the opposite end within the pellet column at the center of the column length. On collision, the pressure is multiplied, at the point of collision, by about 4 to 5 times the normal pressure cited above. To achieve this result, however, the detonation process, particularly the simultaneous firing of the detonators, must be timed precisely in order to assure collision within the explosive column at the center.

[0013] Such precise timing is typically provided by means of mild detonating fuse and special boosters. However, if fuse length is not accurate or problems exist in the booster/detonator connections, the collision may not be realized at all and the device will operate as a "non-colliding" tool with substantially reduced severing pressures.

[0014] The reliability of prior art severing tools is further compromised by complex assembly and arming procedures required at the well site. Laws and regulations require that explosive components (detonator, pellets, etc.) must be transported separately from the tool body. Complete assembly must take place at the well site. Unfortunately, such final assembly is often undertaken in unfavorable working conditions.

[0015] Finally, the electric detonators utilized by prior art severing tools are susceptible to premature detonation due to stray electric currents and RF energy fields.

[0016] An alternative embodiment of the invention that is particularly well suited for single point ignition provides a unitized firing head that is severable from an explosive housing for separate and independent transport to a well site.

SUMMARY OF THE INVENTION

[0017] The pipe severing tool of the present invention comprises an outer housing that is a thin wall metallic tube of such outside diameter that is compatible with the drill pipe flow bore diameter intended for use. The upper end of the housing tube is sealed with a threaded plug having insulated electrical

connectors along an axial aperture. The housing upper end plug is externally prepared to receive the intended suspension string such as an electrically conductive wireline bail or a continuous tubing connecting sub.

[0018] The lower end of the outer housing tube is closed with a tubular assembly that includes a stab fit nose plug. The nose plug assembly includes a relatively short length of heavy wall tube extending axially out from an internal bore plug. The bore plug penetrates the barrel of the housing tube end whereas the tubular portion of the nose plug extends from the lower end of the housing tube. The bore plug is perimeter sealed by high pressure O-rings and secured by a plurality of set screws around the outside diameter of the outer housing tube.

[0019] The tubular portion of the nose plug provides a closed chamber space for enclosing electrical conductors. The bore plug includes a tubular aperture along the nose plug axis that is a load rod alignment guide. Laterally of the load rod alignment guide is a socket for an exploding bridge wire (EBW) detonator or an exploding foil initiator (EFI).

[0020] Within the upper end of the outer housing barrel is an inner tubular housing for an electronic detonation cartridge having a relatively high discharge voltage, 5,000 v or more, for example. Below the inner tubular housing is a cylindrical, upper detonator housing. The upper detonator housing is resiliently separated from the lower end of the inner tubular housing by a suitable spring. The upper detonator housing includes a receptacle socket **31** for an exploding bridge wire (EBW) detonator. The axis for the upper detonator receptacle socket is laterally offset from the outer housing barrel axis.

[0021] Preferably, the severing tool structure is transported to a working location in a primed condition with upper and lower EBW detonators connected for firing but having no high explosive pellets placed between the EBW detonators. At the appropriate moment, the nose plug assembly is removed from the bottom end of the outer housing and a load rod therein removed. The upper distal end of the load rod includes a circumferential collar such as a snap ring. The opposite end of the load rod is visually marked to designate maximum and minimum quantities of explosive aligned along the load rod.

[0022] Explosive pellets for the invention are formed as solid cylinder sections having an axial aperture. The individual pellets are stacked along the load rod with the load rod penetrating the axial aperture. The upper distal end collar serves as a stop limit for the pellets which are serially aligned along the rod until the lower face of the lowermost pellet coincides with the max/min indicia marking. A restriction collar such as a resilient O-ring is placed around the loading rod and tightly against the bottom face of the lowermost explosive pellet.

[0023] The rod and pellet assembly are inserted into the outer housing barrel until the uppermost pellet face contiguously engages the upper detonator housing. The rod guide aperture in the nose plug is then assembled over the lower distal end of the load rod and the lower detonator brought into contiguous engagement with the lowermost pellet face. The assembly is then further compressed against the loading spring between the inner tubular housing and the upper detonator housing until abutment between the nose plug shoulder and the lower distal end of the outer housing tube.

[0024] In the event that the invention severing tool must be disarmed, all pellets may be removed from the housing barrel

as a singular unit about the load rod. This is accomplished by removing the lower nose plug which exposes the lower end of the load rod. By grasping and pulling the load rod from the housing barrel, all pellets that are pinned along the load rod below the upper distal end collar are drawn out of the housing tube with the rod.

[0025] An alternative embodiment of the invention consolidates all of the explosive ignition components into a closed cylinder that is independently packaged and transported.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Relative to the drawings wherein like reference characters designate like or similar elements or steps through the several figures of the drawings:

[0027] FIG. 1 is a sectional view of the invention as assembled without an explosive charge for transport;

[0028] FIG. 2 is a sectional view of the invention with the bottom nose piece detached from the main assembly housing;

[0029] FIG. 3 is a sectional view of an assembled, explosive pellet unit;

[0030] FIG. 4 is a sectional view of the invention with the explosive pellet unit combined with the main assembly housing but the bottom nose piece detached therefrom;

[0031] FIG. 5 is a sectional view of the invention in operative assembly with an explosive pellet unit.

[0032] FIG. 6 is an alternative embodiment of the invention illustrating an independently transported firing head.

[0033] FIG. 7 illustrates a state of arrival for the firing head in a tool arming sequence.

[0034] FIG. 8 illustrates a first step in a tool arming sequence.

[0035] FIG. 9 illustrates attachment of a wireline signal sub to the firing head in the tool arming sequence.

[0036] FIG. 10 illustrates removal of the detonator cover cap in the tool arming sequence.

[0037] FIG. 11 illustrates alignment of an explosive tube cutting tool with the detonator end of the firing head in the tool arming sequence.

[0038] FIG. 12 illustrates the final state of armed tool assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0039] Referring to the FIG. 1 cross-sectional view of the invention **10**, a tubular outer housing **12** having an internal bore **14** is sealed at an upper end by a plug **16**. The plug **16** includes an axial bore **18** and an electrical connector **20** for routing detonation signal leads **22**. A boss **17**, projecting from the base of the plug, is externally threaded for the attachment of the desired suspension string such as an electrical wireline or service tubing.

[0040] An inner housing tube **24** is secured to and extends from the upper end plug **16** into the internal bore **14** of the outer housing **12**. The inner housing tube **24** encloses a capacitive firing cartridge **26**. Below the inner housing **24** is an upper detonator housing **28**. A coil spring **30** links the upper detonator housing **28** to the inner housing tube **24**. An exploding bridge wire (EBW) detonator or exploding foil initiator (EFI) **32** is seated within a receptacle socket formed in the upper detonator housing **28** laterally of the housing axis. Electrical conduits **34** connect the capacitive firing cartridge **26** to the EBW detonator or EFI **32**.

[0041] An exploding bridge wire (EBW) detonator comprises a small quantity of moderate to high order explosive that is detonated by the explosive vaporization of a metal filament or foil (EFI) due to a high voltage surge imposed upon the filament. A capacitive firing cartridge is basically an electrical capacitor discharge circuit that functions to abruptly discharge with a high threshold voltage. Significantly, the EBW detonator or EFI is relatively insensitive to static or RF frequency voltages. Consequently, the capacitive firing circuit and EBW or EFI function cooperatively to provide a substantial safety advantage. An unusually high voltage surge is required to detonate the EBW detonator (or EFI) and the capacitive firing cartridge delivers the high voltage surge in a precisely controlled manner. The system is relatively impervious to static discharges, stray electrical fields and radio frequency emissions. Since the EBW and EFI detonation systems are, functionally, the same, hereafter and in the attached invention claims, reference to an EBW detonator is intended to include and encompass an EFI.

[0042] The lower end of the outer housing tube **12** is operatively opened and closed by a nose plug **40**. The nose plug **40** comprises a plug base **42** having an O-ring fitting within the lower end of the outer housing bore **14**. The plug base **42** may be secured to the outer housing tube **12** by shear pins or screws **44** to accommodate a straight push assembly. Projecting from the interior end of the plug base is a guide tube boss **46** having an axial throughbore **48** and a receptacle socket **50** for a detonator cap **66**.

[0043] Projecting from the exterior end of the plug base **42** is a heavy wall nose tube **52** having a nose cap **54**. The nose cap **54** may be disassembled from the nose tube **52** for manual access into the interior bore **56** of the nose tube **52**. Detonation signal conductor leads **58** are routed from the firing cartridge **26**, through the upper detonator housing and along the wall of housing bore **14**. A conductor channel **60** routes the leads **58** through the nose plug base **42** into the nose tube interior **56**. This nose tube interior provides environmental protection for electrical connections **62** with conductor leads **64** from the lower EBW detonator **66**.

[0044] Although the electrical connections of both EBW detonators **32** and **66** are field accessible, it is a design intent for the invention to obviate the need for field connections. Without explosive pellet material in the outer housing bore **14**, EBW detonators **32** and **66** are the only explosive material in the assembly. Moreover, the separation distance between the EBW detonators **32** and **66** essentially eliminates the possibility of a sympathetic detonation of the two detonators. Consequently, without explosive material in the tubing bore **14**, the assembly as illustrated by FIG. 1 is safe for transport with the EBW detonators **32** and **66** connected in place.

[0045] The significance of having a severing tool that requires no detonator connections at the well site for arming cannot be minimized. Severing tools are loaded with high explosive at the well site of use. Often, this is not an environment that contributes to the focused, intellectual concentration that the hazardous task requires. Exacerbating the physical discomfort is the emotional distraction arising from the apprehension of intimately manipulating a deadly quantity of highly explosive material. Hence, the well site arming procedure should be as simple and error-proof as possible. Complete elimination of all electrical connection steps is most desirable.

[0046] The load rod **70**, best illustrated by FIGS. 2, 3 and 4, is preferably a stiff, slender shaft having an end retainer **72**

such as a "C" clip or snap ring. Preferably, the shaft is fabricated from a non-sparking material such as wood, glass composite or non-ferrous metal. Individual high explosive "pellets" **74** are cylindrically formed with a substantially uniform outer perimeter OD and a substantially uniform ID center bore. The term "pellets" as used herein is intended to encompass all appropriate forms of explosive material regardless of the descriptive label applied such as "cookies", "wafers", or "charges". The axial length of the pellets may vary within known limits, depending on the exact weight quantity allocated to a specific pellet. The pellets are assembled as a serial column over the rod **70** which penetrates the pellet center bore. A prior calculation has determined the maximum and minimum cumulative column length depending on the known weight variations. This maximum and minimum column length is translated onto the rod **70** as an indicia band **76**. The maximum and minimum length dimensions are measured from the rod end retainer **72**. The OD of the end retainer **72** is selected to be substantially greater than the ID of the pellet center bore. Hence the pellets cannot pass over the end retainer and can slide along the rod **70** length no further than the end retainer. When loading the tool with explosive in the field, the correct quantity of explosive **74** will terminate with a lower end plane that coincides within the indicia band **76**. An elastomer O-ring **78** constricted about the shaft of rod **70** compactly confines the pellet assembly along the rod length.

[0047] A lower distal end portion **79** of the rod extends beyond the indicia band **76** to penetrate the guide bore **48** of the bore plug base **42** when the bottom nose plug **40** is replaced after an explosive charge has been positioned. This rod extension allows the high explosive to be manually manipulated as a singular, integrated unit. In full visual field, the explosive charge is assembled by a columned alignment of the pellets over the penetrating length of the rod. When the outside surface plane of the last pellet in the column aligns within the indicia band **76**, the lower end retainer **78** is positioned over the rod and against the last pellet surface plane to hold the column in tight, serial assembly. Using the rod extension **79** as a handle, the explosive assembly is axially inserted into the housing bore **14** until contiguous contact is made with the lower face of the upper detonator housing **28**.

[0048] One of the synergistic advantages to the unitary rod loading system of the invention is use of lighter, axially shorter pellets, i.e. 22.7 gms. These lighter weight pellets enjoy a more favorable shipping classification (UN 1.4S) than that imposed on heavier, 38 gm pellets (UN 1.4D). In a prior art severing tool, the lighter weight pellets would be avoided due to "cocking" in the tool barrel **14** during loading. The loading rod system of the present invention substantially eliminates the "cocking" problem, regardless of how thin the pellet may be.

[0049] With the explosive assembly in place, the lower end of the housing is closed by placement of the nose plug **40** into the open end of the housing. The rod end projection **79** penetrates the guide bore **48** as the plug base **42** is pushed to an internal seal with the housing bore **14**. To assure intimate contact of the opposite end EBW detonators **32** and **66** with the respective adjacent ends of the explosive assembly, the upper detonator housing **28** is displaced against the spring **30** to accommodate the specified length of the explosive column. Accordingly, when the nose plug **40** is seated against the end of the outer housing tube **12**, both EBW detonators are in

oppositely mutual compression as is illustrated by FIG. 5. The severing tool is now prepared for lowering into a well for the pipe cutting objective

[0050] Presently applied Explosive Safety Recommendations require the severing tool 10 to be electrically connected to the suspension string i.e. wireline, etc., before arming ballistically. Ballistic arming with respect to the present invention means the insertion of the explosive Pellets 24 into the housing bore 14.

[0051] On those occasions when the severing tool must be disarmed without discharge, it is only necessary to remove the nose plug 40 and by grasping the rod extension 79, draw the pellets 74 from the tube bore 14 as a single, integrated item.

[0052] An alternative embodiment of the invention, illustrated by FIG. 6, represents an independent firing head tool section 80 wherein all of the explosive initiation components are integrated as a transportable unit separate from the major tool explosive. The independent firing head 80 externally comprises a housing tube 82 that is fitted with removable end caps 84 and 90 that protect and environmentally seal the internal components.

[0053] The upper end cap 84 may be secured by an assembly mechanism such as screw threads 85 internally of the housing tube bore 100 that begin axially from an O-ring seal face 86. The end cap 84 may be a closed plug having corresponding external screw threads 85 leading an O-ring channel 87. Preferably, the internal threads 85 are compatible with external screw threads of a wireline signal sub or other means by which the assembled downhole tool is suspended and actuated.

[0054] The lower end cap 90 also is a closed plug having a deep internal bore 92. The internal bore opening may be provided with an O-ring seal surface 96 followed axially by assembly means such as internal threads 95.

[0055] In a presently preferred design of the firing head 80, the main housing tube includes a primary bore 100 of a first internal diameter extending from the upper end threads 85 to an annular abutment end 102. A secondary bore 104 extends from the abutment 102 to the lower end of the tube 82. The lower distal end 104 of the housing 82 forms a socket boss 104 that is externally seized to receive the internal bore of detonator retainer 106. A cylindrical projection from the base of the detonation retainer 106 provides a detonator socket 107 for securing the position of a detonator element 108 such as a Pacific Scientific EBW Part No. 2-300180.

[0056] External threads 95 for the lower end cap 90 extend from the base of the socket boss 104 to an O-ring 96 channel.

[0057] The axial space within the housing 82 for secure confinement of electronic components is preferably defined between the annular abutment 102 and an internal snap ring 105. Spacing cylinders 110 and 112 of nonconductive materials such as plastic or elastomer isolate and axially confine a capacitor firing cartridge 114 such as the PX-1 fireset by Ecos, Inc. of Houston, Tex. within the primary bore 100.

[0058] At the upper end of the electronic assembly within the primary bore 100 between the snap ring 105 and the upper end of spacer 110 is an electrical contact plug 116 of non-conductive material. Embedded within the plug 116 is an electrically conductive ground surface 117 electrically connected to a ground terminal pin 118. A resilient contact pin 119, preferably positioned along the bore axis, passes axially through the plug 116. Electrically conductive leads 120 and 122 connect the ground surface 117 and resilient contact 119

to the capacitor firing cartridge 114. Electrically conductive discharge leads 124 and 126 connect the firing cartridge 114 to the detonator 108.

[0059] In application, the firing head 80 is delivered to a well head in independent crating or packaging with the end caps 84 and 90 secured in place by meshing threads, for example, as represented by FIG. 7. Also, the firing cartridge 114 is electrically connected to the terminal pin 118 and resilient contact 119. Additionally, the firing cartridge discharge leads 124 and 126 are connected to a socket mounted detonator 108.

[0060] Upon removal from the transport crating, the upper end cap 84 is removed to expose the internal upper threads 85 as shown by FIG. 8. With the end cap 85 removed, a wireline signal sub 130 is attached with a connection adapter 131. This assembly of signal sub 130 engages the wireline carried signal conductors with the ground surface 117 and resilient contact 119 for electrical continuity with the firing cartridge 114. Notably, the end cap 90 has remained in place throughout the wireline connection procedures as shown by FIG. 9 to safely confine any accidental or unintended discharge of the detonator 108. To this end and objective, those of ordinary skill will understand that the end cap 90 should be constructed with sufficient structural integrity to confine an unintended discharge of the detonator 108. Obviously, the type and quantity of explosive used to compound the detonator 108 will determine the parameters of structural sufficiency for the end cap 90.

[0061] At this point, the lower end cap 90 is removed to expose the external screw threads 95 and detonator 108 as illustrated by FIG. 10. Next, an explosive well tool such as a tubing cutter 133 illustrated by FIG. 11 is inserted over the detonator 108 and turned over the threads 95 to the final operational position shown by FIG. 12 with the detonator 108 in ignition proximity with the explosive elements of the tubing cutter 133. The completed assembly is now ready for well placement and discharge.

[0062] Numerous other modifications and variations may be made of the structures and methods described and illustrated herein without departing from the scope and spirit of the invention disclosed. Accordingly, it should be understood that the embodiments described and illustrated herein are only representative of the invention and are not to be considered as limitations upon the invention as hereafter claimed.

1. A method of arming an explosive well tool comprising the steps of:

providing an axially elongated firing head housing having first mechanical assembly means at one end thereof;

securing an explosive detonator means to said housing to project axially beyond said one end of said housing;

enclosing said detonator means by a detonator cover of sufficient structural integrity to confine a detonation of said detonator means;

securing said detonator cover to said housing by said first assembly means;

providing operating signal contact means at an opposite axial end of said housing;

providing a capacitive firing cartridge connected electrically between said signal contacts and said detonator means;

delivering said housing to a well site with said firing cartridge connected to said signal contact means and to said

detonator means and said detonator cover enclosing said detonator means and secured to said first assembly means;

at said well site, with said detonator cover secured to said first assembly means, securing signal carrier means to said opposite end of said housing for signal continuity with said signal contact means;

removing said detonator cover means from said housing; and,

connecting an explosive well tool to said housing at said one end by said first assembly means.

2. A method of arming an explosive well tool as described by claim 1 wherein said explosive well tool connection comprises the step of connecting a shaped charge tubing cutter.

3. A method of arming an explosive well tool as described by claim 1 further comprising the steps of:

providing environmental cover means for said signal contact means;

providing said housing with second mechanical assembly means proximate of said housing opposite end;

securing said environmental cover to said housing by said second assembly means;

delivering said housing to a well site with said environmental cover secured to said second assembly means;

removing said environmental cover from said housing; and

connecting said signal carrier means with said second assembly means.

4. A method of arming an explosive well tool as described by claim 1 wherein said first assembly means is provided with screw threads.

5. A method of arming an explosive well tool as described by claim 3 wherein said second assembly means is provided with screw threads.

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