

[54] SPARK GAP DETONATOR

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[73] Assignee: The United States of America as represented by the United States Atomic Energy Commission, Washington, D.C.

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[58] Field of Search 102/28 R, 46, 70.2

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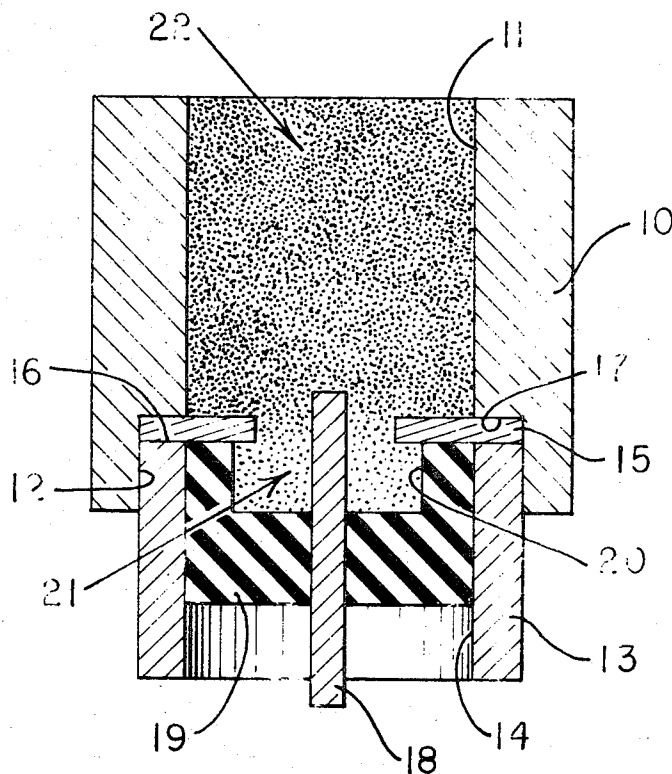
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[57] ABSTRACT

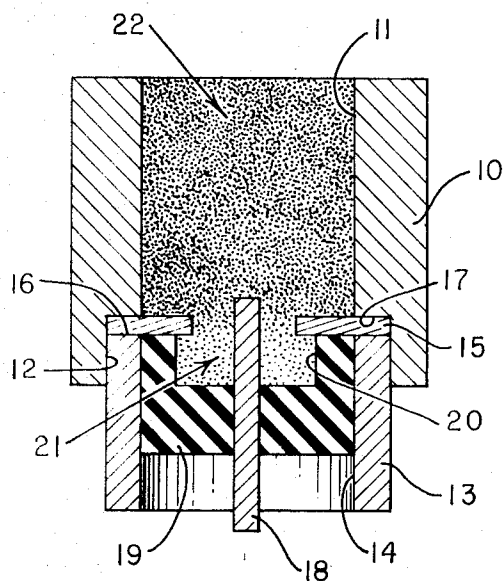
An improved spark gap detonator having a central electrode and surrounding annular electrode which project into a recess formed in one end of the detonator cavity. When explosive powder is pressed into the cavity, the powder flowing past the projecting annular electrode experiences an abrupt pressure drop such that the powder filling the recess packs at a lower density than the powder in the rest of the detonator cavity. This allows the detonator to be filled with only a single powder pressing, while providing a relatively low density powder, which is easier to detonate, adjacent the electrodes, and whereby the electrode configuration has a lower inductance, resulting in a shorter rise time of the firing voltage and hence improved timing of detonation.

7 Claims, 1 Drawing Figure



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SPARK GAP DETONATOR

BACKGROUND OF THE INVENTION

The invention described herein was made in the course of, or under, Contract No. W-7405-ENG-48, with the United States Atomic Energy Commission.

Spark gap detonators of the prior art basically consist of a pair of electrodes inside a chamber packed with an explosive powder. The detonator is fired by applying a high voltage (several kilovolts) to the electrodes. The resulting electrical spark detonates the powder. Prior experience has shown that it is easier to detonate a low density explosive than one of high density. On the other hand, a high density explosive yields more energy than an equal volume of low density explosive. These conflicting requirements have been met in the prior art by packing the explosive powder in two separate pressings. The first pressing is a relatively low pressure and surrounds the firing electrodes with a low density powder (easy to detonate). The second pressing is performed at a higher pressure than the first, thus filling the rest of the detonator with high density powder (more explosive energy). While the prior known detonators have been effective, the cost due to the two powder pressing operations, is considerable.

SUMMARY OF THE INVENTION

The present invention provides an improved spark gap detonator which can be packed with only a single pressing of powder, thereby substantially reducing the cost compared to the prior known detonators while maintaining the effectiveness thereof. The novel detonator utilizes a sharp-edged annular electrode which projects into a recess formed in one end of the detonator cavity. When powder is packed into the cavity, the powder flowing past the projecting electrode edge experiences an abrupt pressure drop (analogous to a fluid flowing through a sharp-edged orifice). This pressure drop causes the powder in the vicinity of the electrode to pack at a lower density than the powder in the remainder of the detonator cavity. The detonator is thus packed with both low and high density powder in a single pressing operation rather than the two separate pressings required by conventional detonators.

In addition to the cost saving in the packing of the detonator as a result of the novel electrode configuration, this electrode configuration has a lower inductance than conventional parallel spaced electrodes. Low inductance in the detonator results in a shorter rise time of the firing voltage, and hence leads to improved timing of detonation.

Therefore, it is an object of this invention to provide an improved spark gap detonator, and method for making same.

A further object of the invention is to provide a spark gap detonator having an electrode configuration which allows packing of the explosive powder in a single operation and which has lower inductance than conventional electrodes.

Another object of the invention is to provide a detonator electrode configuration whereby the explosive powder is packed with relatively low density about the electrodes and with higher density in the remainder of the detonator cavity.

Another object of the invention is to provide an improved spark gap detonator which is more economical

to manufacture and which has improved timing as the result of the electrode configuration.

Other objects and advantages of the invention will become readily apparent from the following description and accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE is a cross-section view of an embodiment of the inventive spark gap detonator.

DESCRIPTION OF THE INVENTION

The invention is directed to an improved spark gap detonator having a central electrode and surrounding annular electrode which project into a recess formed in one end of the detonator cavity. The novel geometry permits the detonator to be filled with only a single pressing of explosive powder rather than the two separate pressings required by conventional detonators. In addition, as a result of the novel electrode configuration there is a lower inductance which results in a shorter rise time of the firing voltage, and hence leads to improved timing of detonation.

Referring now to the illustrated embodiment the improved spark gap detonator comprises an outer sleeve or tubular body member 10 defining an internal chamber 11 and countersunk at one end thereof as indicated at 12; an inner sleeve or cylindrical body member 13 press-fitted into the countersunk section 12 of outer sleeve 10, inner sleeve 13 defining an internal chamber 14 of substantially the same diameter as chamber 11; the chambers 11 and 14 defining a detonator cavity a thin annular or ring-like electrode 15 fixedly secured intermediate an end 16 of inner sleeve 13 and a shoulder 17 of the countersunk section 12 of outer sleeve 10 and in electrical contact with inner sleeve 13, the thin annular electrode 15 projecting into the detonator cavity defined by chambers 11 and 14; a central electrode 18 electrically mounted in and insulated from inner sleeve 13 and annular electrode 15 by an insulator plug or member 19 secured within the chamber 14 of inner sleeve 13, insulator plug 19 containing a cavity 20 at the end thereof adjacent the annular electrode 15 of a diameter greater than the internal diameter of annular electrode 15, central electrode 18 extending through the cavity 20 and beyond the annular electrode 15 as shown.

When explosive powder is pressed into the detonator cavity (chamber 11) the powder flowing past the projecting edge of annular electrode 15 into cavity 20 experiences an abrupt pressure drop due to the increased area of cavity 20 compared to the internal area of annular electrode 15. Therefore, the powder filling the cavity 20 packs at a lower density, indicated at 21 by the widely-spaced dots, than the powder in chamber 11, indicated at 22 by the closely-spaced dots. The detonator is fired by applying a high voltage (several kilovolts), from a power supply not shown, between central electrode 18 and annular electrode 15 via inner sleeve 13. The resulting spark between electrodes 15 and 18 detonates the low density powder 21 in cavity 20 which, in turn, detonates the high density (high energy) powder 22 in the chamber 11.

The fact that the explosive powder can be packed in a single pressing makes the present inventive detonator much more economical to manufacture than conventional detonators requiring two separate powder pressings. Tests have indicated that the hereindescribed det-

onator equals or exceeds the performance of the prior art detonators, as well as being made at a cost reduction of a factor of 5.

In addition to the economic features, another feature of the inventive detonator is the coaxial geometry of the electrode. This novel electrode configuration has a lower inductance than conventional parallel spaced electrodes. Low inductance in the detonator results in a shorter rise time of the firing voltage, and hence leads to improved timing of detonation.

It is thus seen that the present invention provides a spark gap detonator which substantially advances the state of the art.

While a particular embodiment of the invention has been illustrated and described, modifications will become apparent to those skilled in the art, and it is intended to cover in the appended claims all such modifications as come within the spirit and scope of the invention.

What I claim is:

1. A spark gap detonator comprising: a body means defining a chamber therein, said body means comprising a pair of sleeve-like members, one of said pair of sleeve-like members being operatively secured within a countersunk portion of the other of said pair of sleeve-like members, annular electrode means secured in said body means intermediate said pair of sleeve-like members and projecting radially and annularly into said chamber partially dividing said chamber into two sections, said annular electrode having a radially projecting inner periphery of a cross-section less than cross-sections of said two sections of said chamber, central electrode means insulatively secured within said body means in spaced relation with respect to said radially projecting annular electrode means defining an annular space therebetween and extending through at least one of said two sections of said chamber, and explosive powder contained in said chamber, said explosive powder in said one of said two sections of said chamber being at a lower density than the explosive powder in the remainder of said chamber.

2. The spark gap detonator defined in claim 1, wherein said annular electrode means is electrically connected to one of said pair of sleeve-like members.

3. The spark gap detonator defined in claim 1, wherein said central electrode means is insulatively secured in an insulator member, said insulator member being secured in one of said sleeve-like members.

4. The spark gap detonator defined in claim 3, wherein said insulator member is provided with a cavity

at the end thereof adjacent said annular electrode means, said cavity having a larger cross-section than the inner periphery cross-section of said annular electrode means.

5. The spark gap detonator defined in claim 1, wherein said pair of sleeve-like members are constructed so as to contain a substantially identical internal diameter, wherein said annular electrode means is secured intermediate an end of said one of said pair of sleeve-like members and a shoulder portion of said countersunk portion of said other of said pair of sleeve-like members, wherein said central electrode means is insulatively secured in an insulator member secured in said one of said sleeve-like member, said insulator member being positioned in substantial abutment with said annular electrode means and containing a cavity in the portion thereof adjacent said annular electrode means defining said one of said two sections of said chamber and having a diameter larger than the inner periphery cross-section of said annular electrode means, said central electrode extending through said insulator member, said cavity in said insulator member and at least through said annular electrode means.

6. The spark gap detonator defined in claim 5, wherein said annular electrode is electrically connected to said one of said pair of sleeve-like members.

7. A method of manufacturing a spark gap detonator utilizing a single explosive powder pressing operation comprising the steps of: forming a detonator cavity, positioning an annular electrode means in radially and annularly projecting relationship with respect to the cavity dividing the cavity into two sections having cross-sections larger than the inner periphery cross-section of the annular electrode means, positioning a central electrode means in the cavity so as to extend through one of the two sections thereof and in spaced relationship with respect to the radially projecting annular electrode means, electrically insulating the central electrode means from the annular electrode means, and pressing explosive powder into the cavity with the powder flowing past the annular projecting edge of the annular electrode experiencing an abrupt pressure drop such that the powder filling the section of the cavity through which the central electrode extends is at a density lower than the density of the powder filling the other section of the cavity, whereby a spark between the central electrode means and the annular electrode means detonates the lower density explosive powder which detonates the higher density explosive powder.

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