

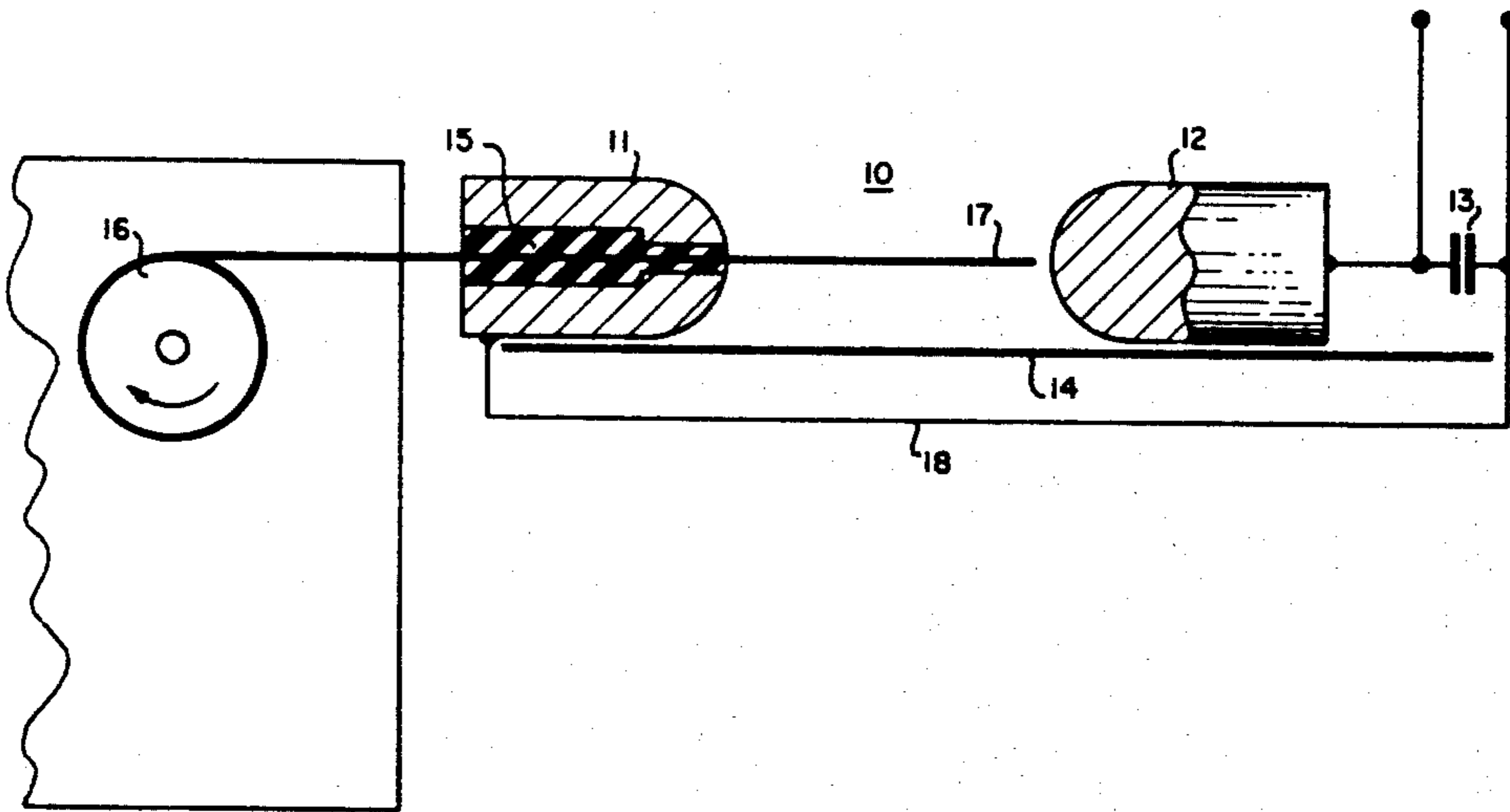
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TRIGGERED SPARK GAP ELECTRIC ARCING DEVICE

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**TRIGGERED SPARK GAP ELECTRIC
 ARCING DEVICE**

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ABSTRACT OF THE DISCLOSURE

This disclosure is directed to an exploding wire spark gap arrangement for under water forming, plasma propulsion and other switching purposes. The arrangement includes oppositely disposed electrodes, one of which has an aperture therein through which an exploding wire is fed. One conductor parallels the gap between the electrodes to magnetically blow the metallic ions formed by the exploding wire away from the ends of the electrode.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention is directed to a spark gap and more particularly to a spark gap having repetitive operation and one in which the electrodes may be spaced a relatively long distance apart.

Heretofore prior art spark gaps have been provided in which a discharge between the two spaced electrodes would break down at a voltage dependent upon the medium, when initiated by a spark, by an increase in voltage, or by a change in pressure. Other types have been provided wherein a bridging wire is used across the electrodes such that the nature of such a discharge device would be a one-shot device requiring reinstallation of a wire across the electrodes for a second shot or other shots.

The present invention overcomes the disadvantages of the prior art exploding wire spark gaps by providing a system which may have repetitive operation or one which may be arranged for repeated shots with very little time involved between shots.

It is therefore an object of the present invention to provide a spark gap in which the spacing between the electrodes may be longer to allow more energy to be dissipated in the gap.

Still another object is to provide means for initiating the spark gap breakdown between spaced electrodes.

Yet another object is to provide a relatively simple, easily made switching device suitable for permitting automatic and continuous repetition of the discharge between the electrodes.

Another object is to provide a high-current, low-inductance spark gap which conforms to parallel conductor geometry suitable for many applications such as plasma propulsion, underwater metal forming and hypervelocity guns.

The exact nature of this invention as well as other objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawings, in which:

The drawing illustrates a plan view partly in section of a switch arrangement made in accordance with the present invention.

Now referring to the drawing, there is shown by illustration in the drawing a plan view of a spark gap made in accordance with the present invention. As shown, the spark gap 10 is made of a pair of oppositely disposed axially aligned electrodes 11 and 12, each having semi-

circular ends that extend with the opposing end in alignment in which the semi-circular ends oppose each other. The electrodes are connected to a capacitor 13 in which one side of the capacitor connects with electrode 12 whereas a conductor 18 which connects electrode 11 with the other side of the capacitor is constructed such that the conductor parallels the two electrodes and is separated therefrom by suitable insulation 14 such that the portion of the electrical conductor 18 that parallels the two electrodes will be insulated from the opposing electrodes. The electrical conductor paralleling the electrodes may be of a plurality of cables or a flat plate conductor, depending on the source to be connected.

Electrode 11 is provided with an axial aperture there-through within which a ceramic sleeve 15 is inserted to provide an opening through that electrode. A spool of fine wire 16 or any other similar electrical conductive material is positioned opposite electrode 11 and the end of the wire 17 thereof extends through the aperture through electrode 11 such that the wire may be extended in a direction toward electrode 12.

In operation, the wire is extended to within a short distance of the electrode 12, the purpose of which will be explained hereinafter. The insulated sleeve within electrode 11 provides a means to prevent the fine wire from being welded to the end of the electrode in use thereof. The wire may be fed through the electrode 11 by a solenoid operation, by an electric motor, manually or by any other suitable system such that the wire is fed through the electrode. If desired, a packet of needle-like wires may be used in lieu of the fine wire spool.

The fine wire extending through electrode 11 enables one to position the electrodes further apart than in other known spark gap electrode switches. This allows more energy to be dissipated in the gap and provides a source of plasma-accelerated particles for certain purposes. The wire acts as an initiator for gap breakdown. Since the wire is very fine and the electrical source is of high energy, the wire between the electrodes will disintegrate which requires additional wire to be fed onto the area for additional discharges between the two electrodes. For continuous operation, the fine wire will be fed continuously into the area between the electrodes. For intermittent operation, other means of feeding the wire into the area between the electrodes may be used.

In operation, the electrodes are assembled and connected to the electrical conductors which are in turn connected to a capacitor or capacitor bank. The capacitor is charged and readied for operation. The fine wire is then passed through the electrode 11 toward electrode 12. When the fine wire approaches electrode 12, an electrical discharge will be made between the fine wire and the electrode 12. The current in the fine wire will then be directed to the electrode 11 and a current path will be established between electrodes 11 and 12. Thus, a spark flow between electrodes 11 and 12 complete the circuit from the capacitor wherein a magnetic field is formed about the conductor backing the electrodes 11 and 12 such that the magnetic forces between the two current paths will force outward the disintegrating fine wire and ionized gases of the electrical discharge between the electrodes. The arc established between the electrodes produces thermal expansion within the area between the electrodes. The current through the backing wire produces an axial magnetic field which forces the hot gases away from the electrodes as described in Magnetic Blow-out Switch, Patent No. 2,936,390. These hot gases may be used for various purposes.

The electrical arcing device of the present invention may be coupled with various other systems to carry out the work function therein. For instance, the electrode arrangement of the present invention may be positioned

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under water adjacent to a die and the forces from the electrode will act upon a work piece to force the workpiece against the die therefore forming the workpiece as desired. Another use would be in the magnetohydrodynamic hypervelocity gun such as found in Patent No. 3,148,587. Such devices also may be used in a plasma propulsion device wherein the wire fed spaced electrodes are positioned to provide the propulsion for the device.

As indicated above, the spark gap for the present arrangement provides a suitable device for producing ions between the electrodes at which the ions are forced outwardly from the electrodes perpendicular to the axis thereof such that the ionic gases can be used for useful purposes.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed and desired to be secured by letters patent of the United States is:

1. An electrical arcing device which comprises:
 - first and second axially aligned elongated electrodes lying in the same plane with opposing ends spaced from each other in end to end relationship,
 - an axially aligned aperture through said first electrode in alignment with said second electrode,
 - an insulating insert within said aperture within said first electrode,
 - an electrical conductor movable through said insulated aperture in said first electrode with a portion thereof protruding therefrom toward said second electrode with the outer end of said protruding portion extending to a point near said second electrode,
 - an electrical conductor electrically connected with said first electrode with a portion of said electrical con-

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ductor extending parallel with said first and second electrodes, and the spacing therebetween, and a layer of insulating material separating said first and second electrodes from said portion of said conductor that extends parallel thereto and to the spacing between said first and second electrodes,

whereby any contaminants within the spacing between said first and second electrodes are forced away from the electrodes during operation of said device.

2. An electrical arcing device as claimed in claim 1, in which:

said electrical conductor is in the form of a spool of conductive wire and positioned relative to said aperture in said first electrode to pass therethrough.

References Cited

UNITED STATES PATENTS

2,481,887	9/1949	Smits	313—311	X
2,936,390	5/1960	Melhart	313—325	X
2,997,623	8/1961	Westendorp	315—36	
3,052,185	9/1962	Apstein	317—80	X
2,499,777	3/1950	Pound	313—325	X
2,935,648	5/1960	Buntenbach	313—325	X
3,207,947	9/1965	Goncz	313—306	X
3,267,320	8/1966	Melhart	313—307	X

FOREIGN PATENTS

940,978 11/1963 Great Britain.

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