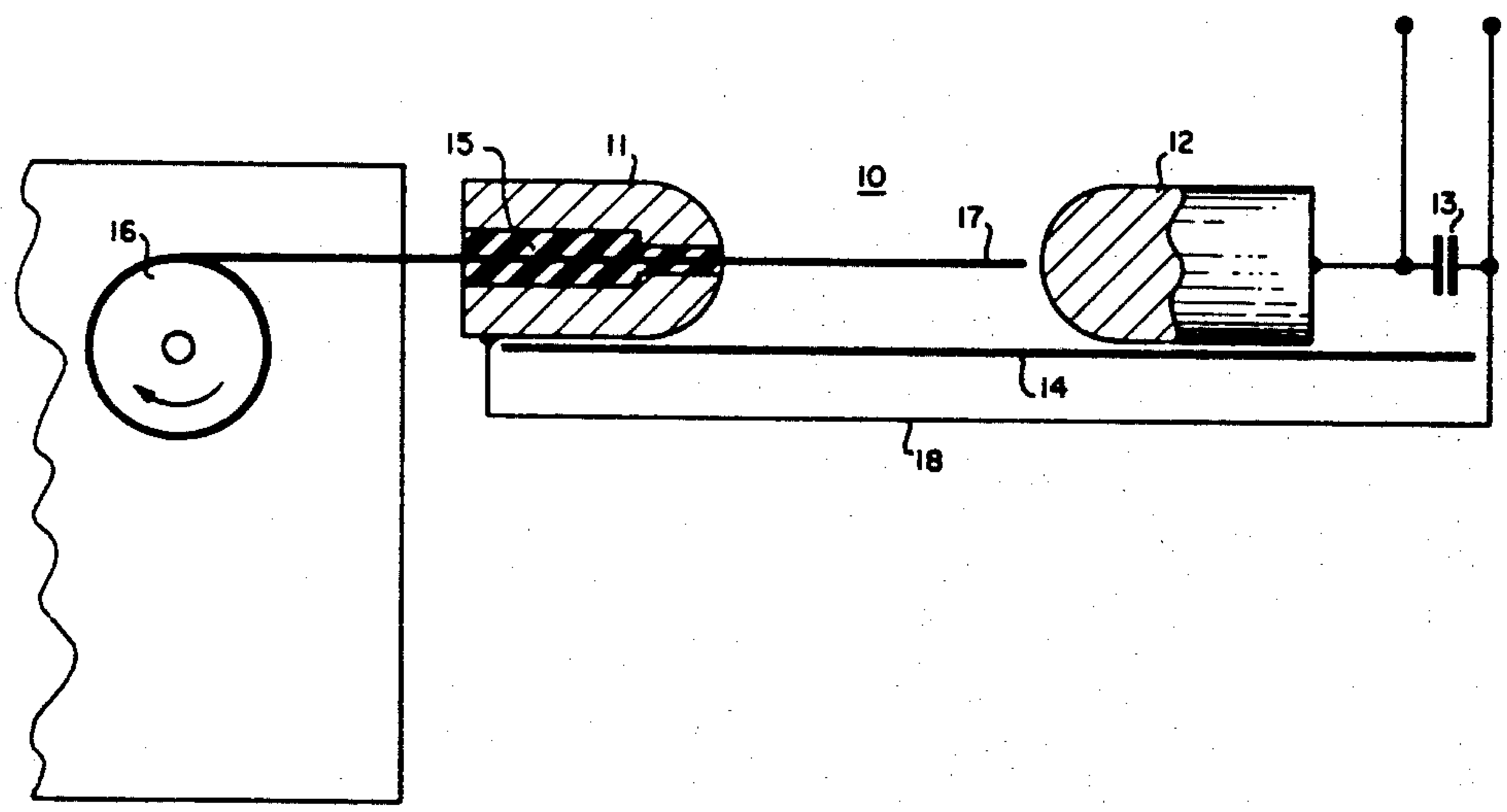
Dec. 24, 1968 L. J. MELHART 3,418,510

TRIGGERED SPARK GAP ELECTRIC ARCING DEVICE

Filed Nov. 30, 1965



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3,418,510

Patented Dec. 24, 1968

3,418,510

TRIGGERED SPARK GAP ELECTRIC ARCING DEVICE

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Filed Nov. 30, 1965, Ser. No. 510,713

2 Claims. (Cl. 313—146)

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 therethrough 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 connectd 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 Blowout 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

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 conductor 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.

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U.S. Cl. X.R.

313—311, 325; 315—36; 317—60