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HIGH-PRESSURE MODULATOR TUBE

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Fig. 1.

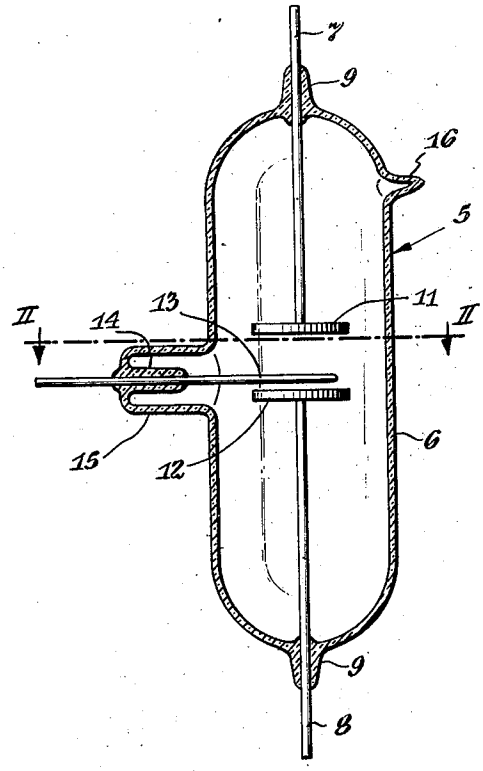


Fig. 3.

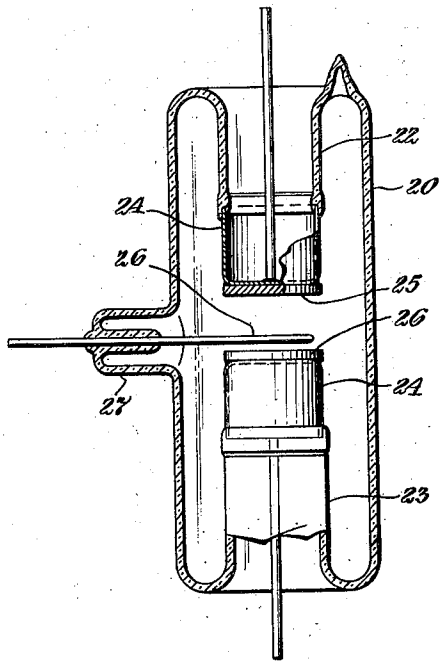
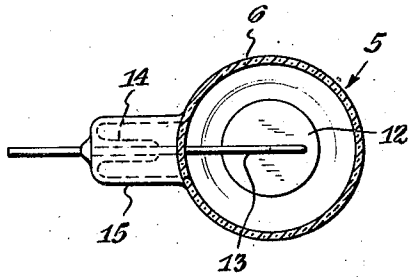


Fig. 2.



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HIGH-PRESSURE MODULATOR TUBE

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7 Claims. (Cl. 250—27.5)

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The present invention relates to what is termed a high pressure modulator gap or a triggered spark-gap device commonly employed in connection with the transmission and reception of high frequency waves and constitutes an improvement over the structure shown and described in copending application, Serial No. 491,496, filed concurrently herewith and assigned to the same assignee as the present invention.

Devices of this general type are known to the art but have heretofore been subject to the disadvantages that they have been of relatively short life and operate at comparatively low voltages. Moreover, they have been erratic or unstable in performance.

It is accordingly an object of the present invention to provide a triggered spark-gap device which operates under substantially stable conditions during a relatively long useful life.

Another object of the present invention is the provision of a triggered spark-gap device which requires a relatively low triggering voltage to initiate a discharge.

Another object of the present invention is the provision of a triggered spark-gap device which operates with low energy dissipation and will pass comparatively high power while causing initiation of the main discharge at much lower voltages than otherwise.

A further object of the present invention is the provision of a triggered spark-gap device which is of simple yet rugged construction and thus economical to manufacture.

Still further objects of the present invention will become obvious to those skilled in the art by reference to the accompanying drawing wherein:

Fig. 1 is an elevational view of a triggered spark-gap device constructed in accordance with the present invention;

Fig. 2 is a sectional view taken on the line II—II of Fig. 1, and

Fig. 3 is an elevational view showing a modified construction which the spark-gap of the present invention may have.

Referring now to the drawings in detail, the triggered spark-gap device 5 of the present invention as shown in Fig. 1 comprises an envelope 6 formed of vitreous material such as glass, quartz, or the like. Leading-in and supporting conductors 7 and 8 are sealed at 9 to the vitreous envelope 6 and, as shown, each conductor supports an electrode 11 and 12 formed of suitable metal such as molybdenum or tungsten. These opposing electrodes 11 and 12 are of disc shape with their surfaces parallel and positioned at

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approximately the center of the envelope with a spacing therebetween of about 6 to 16 mm., depending on the voltage.

A trigger electrode 13 which may comprise a tungsten rod of .100 inch diameter is sealed to a reentrant press 14 forming part of a side-arm 15. This trigger electrode is spaced a small distance of approximately 1.5 mm. above the the electrode 12 and, as shown in Fig. 2, extends diametrically across the latter with its end a short distance from the peripheral edge of the electrode 12. After fabrication of the device 5, it is treated and exhausted at 16 in the customary manner and then filled with an ionizable medium at high pressure.

In triggered spark-gap devices of the present invention the operating voltage is determined by the spacing between the electrodes and the nature and pressure of the ionizable medium. Likewise these same factors control the triggering voltage required to initiate the arc between the main electrodes. It has been found that for high voltage operations of spark-gap devices of the present invention, it is necessary to introduce a small percentage of oxygen or other impurity into the inert gas constituting the ionizable medium which is at a pressure ranging from 3 to 5 atmospheres. Heretofore this has resulted in the impurity "cleaning-up" during the life of the spark-gap device by combination with the electrode material which is sputtered off the negative electrodes.

Consequently, unsatisfactory operation has resulted because, as the oxygen or other impurity is cleaned up, the maximum operating voltage of the device is lowered and the loss of material from the electrodes, especially from the trigger electrode, changes the characteristics of the gap and causes unstable operation. These effects are materially reduced by the above-described construction by filling the tube with an ionizable medium, such as argon together with a small percentage of oxygen; helium and oxygen; or a mixture of argon, helium and oxygen, at a total pressure of 3 to 5 atmospheres. As a more specific example of a device constructed in accordance with the present invention and with the electrode spacings as above noted, an ideal gaseous mixture was found to comprise 20 lbs./in.^{2} of argon, 20 lbs./in.^{2} of helium, and 4 lbs./in.^{2} of oxygen (total pressure of approximately 3 atmospheres). Such device operated a total of 450 hours with the voltage ranging from 10 to 19 kilovolts. Moreover, tests indicated that the mixture of argon and helium with the oxygen

gave somewhat more stable operation over the range of 10 to 19 kilovolts than either of the inert gases alone with oxygen.

In operation a high voltage is applied between the two disc electrodes 11 and 12 and a voltage impulse is impressed between the trigger electrode 13 and main electrode 12 which ionizes the medium within the envelope and initiates a discharge. This discharge appears to be in the form of two high current arcs in series, one between the trigger electrode 13 and the upper main electrode 11 and the other between the trigger electrode 13 and lower main electrode 12. Accordingly, one of the main electrodes apparently functions as an anode and the other as cathode, while the trigger electrode 13 acts as both an anode and cathode.

Due to the construction as shown, the two arcs move along the spaces between the trigger electrode 13 and the disc electrodes, thus utilizing a much larger surface area than in previous type triggered spark-gap devices where the arcs are relatively fixed in position and the cathode spot is stationary. This utilization of greater electrode area allows the use of a larger amount of oxygen or other impurity in the gas mixture since more of the electrode material can be lost before the electrode spacing is changed appreciably. Considerably longer commercial life thus results because the loss of electrode material does not affect the electrode spacing to an appreciable extent, resulting in more stable operation during the entire useful life of the device.

The structure shown in Fig. 3 operates in the identical manner as that shown in Fig. 1 and differs therefrom only in constructional details. For example, in Fig. 3 the envelope 20 is provided with oppositely disposed reentrant stems 22 and 23, to each of which is sealed a closure member 24 and constituting the lead-in sealed to the envelope. These members are in the form of a metallic cup made of an alloy such as "Kovar" and having substantially the same coefficient of expansion as that of the glass envelope. Again, the main electrodes 25 and 26 are of tungsten or molybdenum in disc form brazed or welded to the closed end of the "Kovar" cups or leading-in and supporting conductors 24, and the trigger electrode 26 enters through a side arm 27 and extends diametrically across the electrode 26 just short of the peripheral edge of the latter in the same manner as previously described relative to Fig. 1.

It thus becomes obvious to those skilled in the art that a high pressure modulator gap or triggered spark-gap device is herein shown and described which operates with stability over a comparatively long useful life. Moreover, by utilizing electrodes of relatively large area, wear of such electrodes due to sputtering is materially reduced, as is "clean-up" of the gaseous atmosphere which otherwise unites with the sputtered electrode material with resultant shortening of useful life of the device.

Although several embodiments of the present invention have been shown and described, it is to be understood that still further modifications thereof may be made without departing from the spirit and scope of the appended claims.

We claim:

1. A high pressure and triggered spark-gap device comprising an envelope, a pair of disc-shaped main electrodes in said envelope for supporting a high current arc discharge during operation of said device, an ionizable medium in said envelope at high pressure greater than one atmosphere, and a trigger electrode disposed parallel to the surface of said main electrodes and operable upon the application of a potential between said trigger electrode and the adjacent main electrode to initiate the high current discharge in said device.

2. A high pressure and triggered spark-gap device comprising an envelope, a pair of disc-shaped main electrodes in said envelope for supporting a high current arc discharge during operation of said device, an ionizable medium in said envelope at a pressure ranging from one to five atmospheres, and a trigger electrode disposed closer to one of said main electrodes than to the other and extending diametrically to the surface of the adjacent main electrode and operable upon the application of a potential between said trigger electrode and the adjacent main electrode to initiate the high current discharge in said device.

3. A high pressure and triggered spark-gap device comprising an envelope, a pair of disc-shaped main electrodes in said envelope for supporting a high current arc discharge during operation of said device, an ionizable medium in said envelope at a pressure ranging from one to five atmospheres and including a non-inert gas, and a trigger electrode disposed closer to one of said main electrodes parallel to the surface thereof than to the other of said main electrodes and operable upon the application of a potential between said trigger electrode and the adjacent main electrode to initiate the high current discharge in said device.

4. A high pressure and triggered spark-gap device comprising an envelope, a pair of oppositely disposed disc-shaped main electrodes in said envelope with their surfaces parallel to each other and normal to the longitudinal axis of said envelope for supporting a high current arc discharge during operation of said device, an ionizable medium in said envelope at a pressure ranging from one to five atmospheres, and a trigger electrode disposed closer to one of said main electrodes parallel to the surface thereof than to the other of said main electrodes and operable upon the application of a potential between said trigger electrode and the adjacent main electrode to initiate the high current discharge in said device.

5. A high pressure and triggered spark-gap device comprising an envelope, a pair of oppositely disposed disc-shaped main electrodes in said envelope with their surfaces parallel to each other and normal to the longitudinal axis of said envelope for supporting a high current arc discharge during operation of said device, an ionizable medium in said envelope at a pressure ranging from one to five atmospheres, and a rod-like trigger electrode in juxtaposition to one of said main electrodes and extending diametrically relative thereto just short of the peripheral edge of said adjacent main electrode, and operable upon the application of a potential between said trigger electrode and the adjacent main electrode to initiate the high current discharge in said device.

6. A high pressure and triggered spark-gap device comprising an envelope, a leading-in and supporting conductors hermetically sealed to said envelope, a disc-shaped main electrode secured to each of said leading-in and supporting conductors with their surfaces parallel to each other and normal to the longitudinal axis of said envelope for supporting a high current arc dis-

charge during operation of said device, an ionizable medium in said envelope at a pressure ranging from one to five atmospheres, and a rod-like trigger electrode in juxtaposition to one of said main electrodes and extending diametrically relative thereto just short of the peripheral edge of said adjacent main electrode, and operable upon the application of a potential between said trigger electrode and the adjacent main electrode to initiate the high current discharge in said device.

7. A high pressure and triggered spark-gap device comprising an envelope, leading-in and supporting conductors hermetically sealed to said envelope, a disc-shaped main electrode secured to each of said leading-in and supporting conductors with their surfaces parallel to each other and normal to the longitudinal axis of said envelope for supporting a high current arc discharge during operation of said device, an ionizable medium in said envelope at a pressure ranging from one to five atmospheres comprising a gaseous mixture of inert gas and oxygen, and a rod-like trigger electrode in juxtaposition to one of said main electrodes and extending diametrically relative thereto just short of the peripheral

edge of said adjacent main electrode, and operable upon the application of a potential between said trigger electrode and the adjacent main electrode to initiate the high current discharge in said device.

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