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APPARATUS FOR PRODUCING HIGH VELOCITY SHOCK WAVES AND GASES

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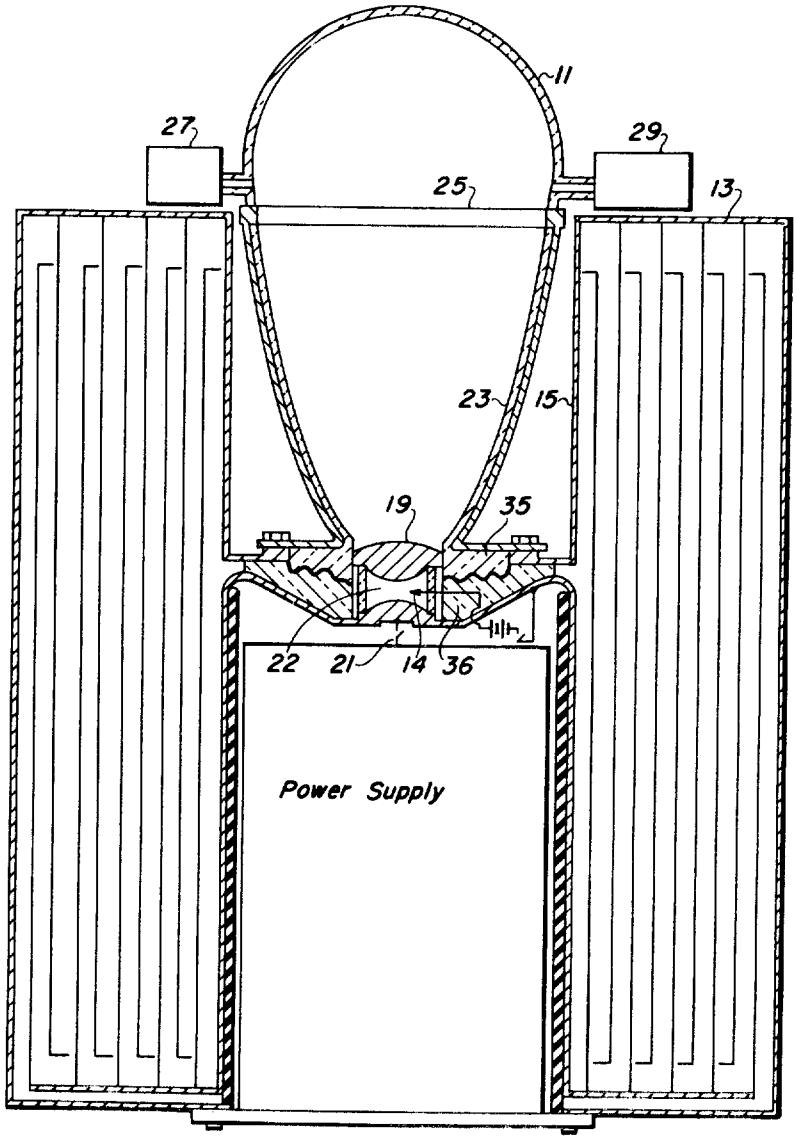

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APPARATUS FOR PRODUCING HIGH VELOCITY SHOCK WAVES AND GASES

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2 Claims. (Cl. 315—59)

The present invention relates to apparatus for producing shock waves or detonations of very short duration and fast rise-time. Such shock waves are useful for producing light flashes for high speed photography, or for producing X-rays or neutrons, depending on the type of gas utilized.

A mass of rarified gas in a container is suddenly ionized to produce a shock wave. The container in which the shock wave is produced is tapered in longitudinal configuration in order that the ionized gas or plasma will be rapidly accelerated to a very high velocity.

It has been found that when such shock waves are produced with sufficient energy and a suitable gas is utilized a source of prolific X-rays and/or a source of neutrons is produced. The present invention provides a compact and portable shock wave, X-ray or neutron source.

It is, accordingly, a prime objective of the present application to provide a device for producing high velocity shock waves in a gas.

It is the further objective of the present invention to provide a novel portable X-ray and/or neutron source.

The above and other objectives and advantages of the present invention will become apparent from the following description and drawing made a part of this specification.

Referring to the drawing, a tapered gas discharge vessel 23, hereinafter termed a "shock tube," made of nonconducting material surrounded by an envelope or sheath of conducting material, houses at its small end an electrical switch comprising an electrode 19 and a contactor 21. A second electrode 25 has an annular configuration and is supported at the large end of the tapered section of the discharge vessel.

The vessel is completed by a transparent dome section 11 of substantially hemispherical configuration which is hermetically attached to the large end of the shock tube.

It is desirable to utilize select gases in a device and to this end a getter container 27 is provided in communicative relationship with the interior of the vessel to eliminate vestiges of unwanted gases. Atoms of select gas are supplied from a source 29 herein termed "an emitter" and which is shown connected to and communicating with the interior of the vessel.

The two electrodes 19 and 25 constituting the ionization electrodes are connected in series with a source of potential 13 and a spark gap 22. The operation of the switch contactor 21 charges capacitor 13. Trigger electrode 14 fires the spark gap in a manner well known in the art and impresses the total potential of the power source across the gaseous medium between electrodes 19 and 25 in the tapered tube.

The imposition of the ionizing potential in the gas within the tapered tube produces a conical gaseous discharge. The high currents produced in the discharge tend to localize, or pinch, at the axis of the tube by virtue of the self-magnetic field. Since the radius of the discharge vessel is less at the small end than at the large end, the compressed ionized zone, or pinch, arrives at the region in the axis at the small end of the discharge vessel earlier than at the large end and starts a mass motion of the heated plasma into the region not yet pinched. This action continues toward the large end of the tube where the shock wave is then driven into the hemispherical end portion of the device.

The high velocity shocks, and the X-rays and/or neutrons produced in the tapered shock vessel are dependent on the value of the current during the discharge period, and it is therefore desirable that the amplitude of the discharge be as great as possible. To this end the components have been arranged to take advantage of a very low inductance coaxial condenser 13 surrounding the power supply and the shock vessel. The capacitor constitutes the power source for energizing the shock wave vessel.

The device is useful as a neutron source by utilizing deuterium gas. For its use as an X-ray or light source, it has been found desirable to utilize argon gas at about 50 μ.

In such a device, the shock wave vessel is subject to gradual degradation, and it is accordingly desirable that it be replaced. It is provided at its smaller end with an end flange portion 35 adapted to be seated on and sealed to a mating fixed base flange portion 36. The mating flange surfaces may be flat or contain annular ridges, or otherwise provided with surfaces well known in the art to produce a hermetical joint. The shock tube flange portion may be clamped to the base flange portion as, for example, by a twist lock device, clamps, bolts or any other suitable clamping means.

An apparatus in accordance with the foregoing description has produced high velocity shocks of the order of about 100 Mach by discharging a 10 microfarad condenser charged to 25 kilovolts between the electrodes.

The foregoing has described a preferred portable embodiment of my invention in which very high velocity shock waves can be produced and which are suitable for producing light flashes, X-rays or neutrons, as well as for laboratory studies of the effects of intense ionization of selected gases. It is understood however, that other embodiments within the spirit of this invention are possible, and therefore the invention is not to be considered limited by the embodiment shown, but only by the appended claims taken in view of the prior art.

What is claimed is:

1. A device for producing a high energy ionized gas region comprising an evacuated tapered insulating vessel and a substantially hemispherical insulating cap hermetically affixed to the large end of said vessel, an annular electrode having a diameter equal to and supported in the wall of said vessel at the large end thereof and having a conductive portion inside the vessel, a second electrode supported at the small end of said vessel, means connected to said vessel for introducing a selected gas therein; a source of high potential having two poles, means for connecting one pole of said high potential source to the annular electrode and means for connecting the other pole of said potential source to said second electrode.

2. The device of claim 1 in which said source of electric potential is an annular electrical condenser in which the inner radius is at least the radius of said discharge vessel, and means for supporting at least a part of said vessel within the annular space so provided.

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