May 17, 1960 W. J. NOLAN, JR 2,937,299

CAPILLARY SPARK LIGHT SOURCE

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FIG. 1

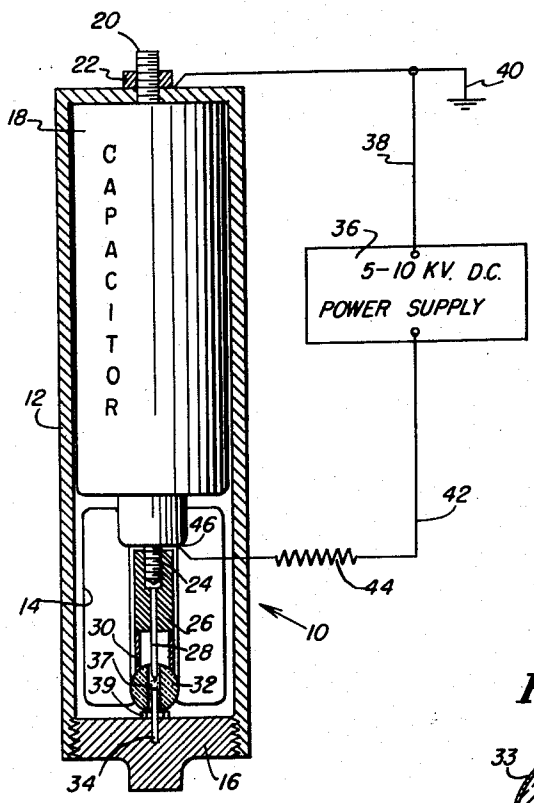
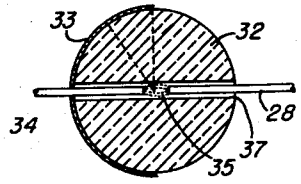


FIG. 2



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CAPILLARY SPARK LIGHT SOURCE

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3 Claims. (Cl. 313—113)

This invention relates to new and useful improvements in electric spark discharge lights and more particularly to an improved spark discharge light in which the spark electrodes are enclosed within a capillary passage in a transparent member.

In recent years there have been developed improved electric spark discharge lights for producing high intensity flashes of short duration. These spark discharge lights have proved to be very effective as high intensity light sources for photographic work, for stroboscopic observation and for optical range finding equipment. In the electric spark discharge light, a high voltage power supply is used to charge an electrical condenser which is then discharged across a pair of spark electrodes. In some spark discharge lights a trigger electrode is used to initiate an ionized path for the discharge of a spark between the main spark electrodes. In the development of spark discharge lights as a light source for optical range measuring equipment one of the problems which has arisen and which has not been satisfactorily solved is that of the uncertain location of the spark with respect to the electrodes. The spark has a tendency to wander over the electrode surface and produces an erratic and incomplete illumination of the target. If the electrodes are brought to a sharp point the condition may be improved somewhat, but electrode wear becomes so rapid as to be intolerable and break down voltage varies substantially from pulse to pulse.

It is therefore one object of this invention to provide an improved spark discharge light which is capable of producing a high intensity confined spark.

Another object of this invention is to provide an improved spark discharge light in which spark wander is substantially eliminated and the light is concentrated at a substantially fixed location.

A feature of this invention is the provision of an electric spark discharge having a pair of spark discharge electrodes which discharge in a capillary passage through a transparent member.

Another feature of this invention is the provision of a spark discharge light having a pair of spark discharge electrodes which are positioned in the capillary passage through a sphere formed of a transparent material such as quartz or the like, and having a reflective coating over approximately half of the sphere to reflect light back to a selected point.

Other objects and features of this invention will become apparent from time to time throughout the specification and claims as hereinafter related.

In the accompanying drawing, to be taken as a part of this specification, there is clearly and fully illustrated a preferred embodiment of this invention in which drawings;

Fig. 1 is a view in cross-section of an improved spark discharge light having electrodes discharging in a capillary passage, and showing one possible schematic wiring diagram for the light, and

Fig. 2 is a detail sectional view of the quartz sphere and capillary passage therein in which the spark electrodes are positioned.

This invention comprises an improved spark discharge light having a pair of spark discharge electrodes arranged for discharge from a capacitive discharge circuit. The spark discharge electrodes are positioned in a capillary passage through a sphere of a transparent material such as quartz or the like so that the spark is closely confined in the capillary passage and spark wander is thus eliminated. The quartz sphere may, if desired, be provided with a reflective coating over a portion of the surface to concentrate and reflect light back to the light source or any other selected point.

Referring to the drawings by numerals of reference and more particularly to Fig. 1, there is shown a spark discharge light assembly **10** which is enclosed and supported within a metal casing **12**. Casing **12** has a plurality of openings **14** around the lower end thereof and has a removable metal plug or end wall **16** at said lower end. A capacitor **18** is positioned within the upper portion of the casing **12** and has a threaded terminal **20** extending through the end wall of the casing and secured in place by a threaded nut **22**. At the other end of the capacitor **18** there is a threaded projection **24** constituting the second terminal of the capacitor on which is supported an electrode holder **26** having a spark electrode **28** therein. The electrode holder **26** abuts a spacer member **30** which in turn abuts and secures in place a transparent sphere **32** of glass, quartz, or the like.

The sphere **32** has an aperture **37** of capillary size therein which receives the lower end of the spark electrode **28**. The sphere **32** rests on a ring-shaped support **39** on the removable wall or plug **16**. A second spark electrode **34** is secured in the removable wall or plug **16** and extends in to the capillary opening **37** in the quartz sphere **32**. The quartz sphere **32**, as shown in Fig. 2, may be provided with a reflecting coating **33** of aluminum or other metal which reflects stray light back to the spark zone as indicated by the dotted lines in Fig. 2.

This spark discharge light is energized intermittently from a D.C. power supply **36** which may provide a voltage of the order of 5,000 to 10,000 volts. The power supply **36** is connected as by a lead **38** to the terminal **20** on the capacitor **18** and is also connected to ground as indicated at **40**. The power supply **36** is also connected by a lead **42** to a resistor **44** which may have a resistance of the order of 500,000 ohms. The resistor **44** is connected as at **46** to the other terminal of the capacitor **18**. The capacitor **18** may have a capacitance of the order of 0.1 mfd. and be rated 5,000 volts.

Operation

In operation the power supply **36** is arranged to provide an intermittent source of D.C. power to charge the capacitor **18**. The capacitor **18** when fully charged will discharge through the electrodes **28** and **34** to produce a spark discharge **35**. The spark discharge **35** is confined within the capillary passage **37** in the quartz sphere **32** and thus is not permitted to wander about the surface of the spark electrodes.

The volume occupied by the spark is a function of the energy dissipated and if the energy is not sufficient to create a spark large enough to fill the capillary passage then spark wander may still occur. However, when the energy is increased above that necessary to fill the capillary passage with the spark a substantial increase in brightness is obtained over the brightness produced by an open spark. With very high spark energies, however, it is necessary to use material of substantial thickness to confine a spark within the capillary passage since the

high energy of the spark may shatter the transparent member through which the capillary passage **37** extends.

It is necessary to allow a substantial clearance between the electrodes **28** and **34** and the walls of the capillary passage **37** so that material which is sputtered off the electrodes during the spark and products of decomposition of the glass or quartz will be blown out of the region of the spark gap. If this clearance is not provided, the material sputtered off the electrodes during the spark and products of decomposition of the glass will form on the surface of the passage **37** an opaque film which is electrically conducting and which will short out the electrodes **28** and **34**. This spark light has been successfully operated using electrodes .020 inch in diameter, positioned in a capillary passage, .030 inch diameter, and having spark energies of about 0.5 joule.

While this spark light assembly is illustrated with a spark electrode positioned in a capillary passage through a glass or quartz sphere, it is possible to position electrodes in a capillary passage through a transparent member of other shapes such as a cylinder or prism. The spherical shaped member **32** is preferred, however, for an optical measuring system. Since the usual optical system collects light from only a limited angle, it is possible to increase the brightness of the light source by coating the unused portion of the surface of the sphere with a reflecting material **33** such as aluminum to return the otherwise wasted light to the spark zone. The effectiveness of this reflector coating of course depends on the absorption characteristics of the spark. While the sphere **32** has been described as being formed of glass or quartz, other materials such as sapphire or other transparent crystalline material may be desired because of considerations of mechanical strength and of light transmittance requirements of the optical system in which this light is used.

I claim:

1. A spark discharge device including in combination, a transparent spherical member having a capillary passage extending therethrough along a diameter thereof, and a pair of spark electrodes positioned in said passage and forming a spark gap at substantially the center of said spherical member, said spark electrodes being adapted to be connected in a high voltage circuit to produce a spark discharge at said gap, with the discharge path being defined by said passage to prevent spark wander, said electrodes being spaced slightly from the surface of said passage to provide an escape path for erosion products caused by said spark discharge.

2. A spark discharge device including in combination, a transparent member having a spherical outer surface and a capillary passage therein, a pair of spark electrodes positioned in said passage and adapted to be connected in a high voltage circuit to produce a spark discharge in said passage, said electrodes being spaced from the surface of said passage to provide an escape path for erosion products, and a reflective coating on a portion of said spherical surface of said transparent member for reflecting light radiation and returning the same to said passage.

3. A spark discharge device including in combination, a transparent member having a spherical outer surface and a cylindrical capillary passage therein, a pair of spark electrodes positioned in said passage and adapted to be connected in a high voltage circuit to produce a spark discharge between said electrodes, with the discharge path being defined by said passage to prevent spark wander, said electrodes being substantially smaller in diameter than said passage to provide an escape path for erosion products, and a reflective coating on a portion of said spherical outer surface of said transparent member for reflecting light radiation and concentrating the same in said capillary passage to increase the temperature therein and thereby increase the brightness of light radiation.

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