July 23, 1968 H. FLEISHMAN ETAL 3,393,967

LIGHT SOURCE

Filed May 6, 1966

FIG. 1

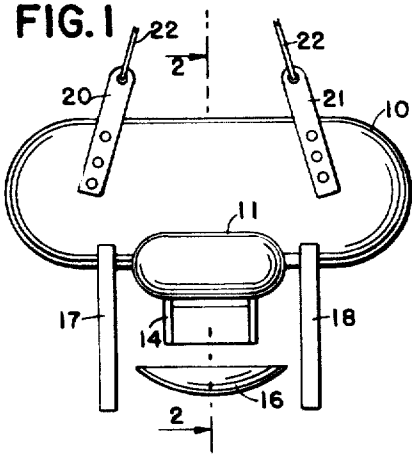


FIG. 2

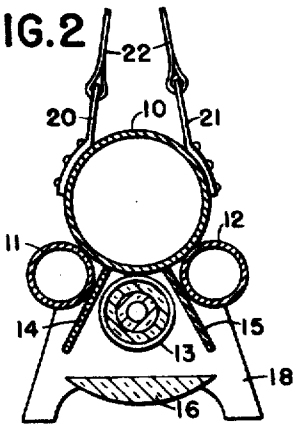


FIG. 3

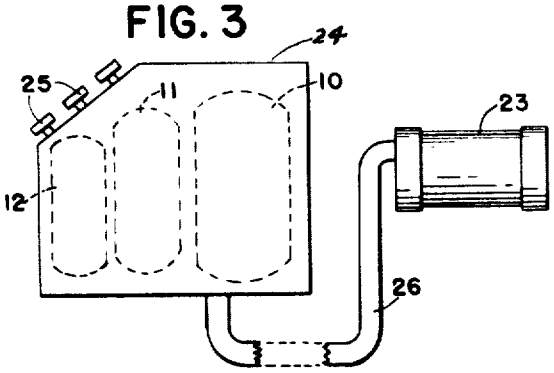


FIG. 4

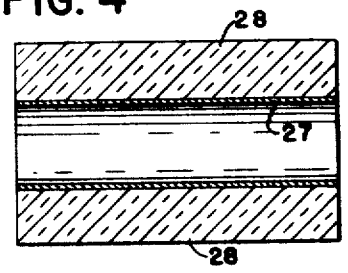
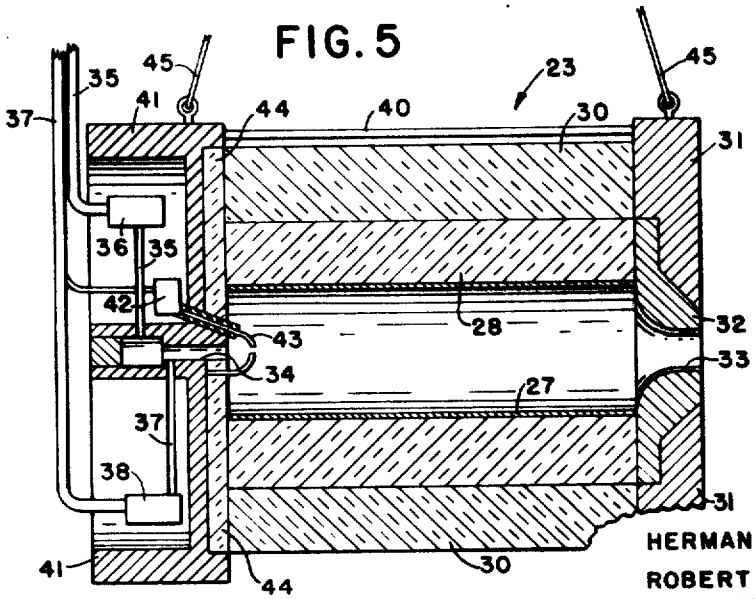


FIG. 5



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LIGHT SOURCE

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ABSTRACT OF THE DISCLOSURE

A tubular combustion chamber of optically transparent fused quartz provides light through the heating to incandescence, in or on the chamber, of spectrally emissive matter in the visible region, or of the inside surface of the quartz chamber, or both. Burning gases are introduced into one end of the tubular chamber and exhausted from a tapered orifice at the other end.

This invention relates to a light source for illuminating a large area. The invention has particular relationship to a light source which may be attached to a helicopter or some other airborne vehicle for illuminating a large land area beneath the vehicle. Many types of lamps have been designed for high intensity use, the most successful of which is the electric arc lamp. While this source of illumination produces an intense point source of light which can be focused into a concentrated beam, the equipment necessary for maintaining the arc is quite expensive and very heavy. Many other types of intense light sources have been produced but they all use electrical power and require considerable auxiliary equipment. The light source described herein uses no electrical power except for ignition. Two containers of gas or fluid are all that is required to maintain the source for a considerable length of time. The auxiliary equipment is not heavy and the lamp itself is a small compact unit and does not include any evacuated chambers.

One of the objects of this invention is to provide an improved light source which avoids one or more of the disadvantages and limitations of prior art lamps.

Another object of the invention is to provide an intense source of light for illuminating a large area.

Another object of the invention is to generate luminous flux by the combination of a liquid or gas fuel and a gas oxidizer.

Another object of the invention is to reduce the cost and complexity of light generating units.

Another object of the invention is to provide a light generator which is rugged and has a long operating life.

Another object of the invention is to provide a light generating device whose light producing characteristics are not effected by atmospheric conditions.

The light source includes a hollow cylindrical tube of fused quartz having a mixing chamber at one end and an exit orifice at the other end. A first conduit is connected to the mixing chamber for supplying a liquid fuel. A second conduit is also connected to the mixing chamber for supplying an oxidizing gas. An igniter means, such as a spark plug, is positioned at the mixing chamber for igniting the mixture of fuel and oxidizing gas and thereby provides a flame for heating the quartz tube to incandescence.

For a better understanding of the present invention, together with other and further objects thereof, reference is made to the following description taken in connection with the accompanying drawings.

FIG. 1 is a side view of the lamp housing mounted below fuel and oxidizing tanks.

FIG. 2 is a cross sectional view of the arrangement shown in FIG. 1 and is taken along line 2—2 of that figure.

FIG. 3 is an alternate form of the invention showing a tank container and a control unit mounted exterior to the lamp which is connected to the control unit by a long supply cable.

FIG. 4 is a cross sectional view of a portion of the lamp unit showing the quartz tube with an auxiliary layer of light producing substance.

FIG. 5 is a cross sectional view showing the details of the combustion chamber, the mixing chamber, and the supporting fixtures.

Referring now to the drawings, FIG. 1 shows a large tank **10** which may hold the oxidizing gas such as oxygen. Mounted below tank **10** is a second tank **11** which holds a fuel, either gas or liquid. A third tank **12** may be mounted on the other side of the assembly and may hold other gases or fluids such as nitrogen for pressurizing the liquid fuel. The light source itself **13** is mounted directly below tank **10** and may be positioned between two reflectors **14** and **15**. The reflectors help to intensify the light directed downwardly and they form a barrier which prevents the light source **13** from illuminating the airborne vehicle which is supporting the source. A lens **16** may be mounted below the reflectors, but this is not always necessary and may be omitted. Two or more supports **17** and **18** may be secured to tank **10** for supporting the arrangement on the ground prior to being airborne. One or more brackets **20** and **21** are secured to the tank **10** for support by cables **22** when the device is lowered from an airplane or helicopter during flight.

FIG. 3 shows the preferred arrangement whereby a light source **23** is provided with cables **22** with the three tanks **10**, **11**, and **12** housed within a compartment **24** having a control panel **25** for operation by an operator within the helicopter. The housing **24** is supported in the helicopter or other vehicle and is connected to the light source **23** by means of a cable **26**, this cable including flexible conduits for transmission of the gases and an electric transmission line for providing the spark plug with electrical energy for igniting the gas mixture.

FIG. 4 shows the fused quartz cylinder with an added layer of material which gives added brightness to the interior surface of the cylinder. This additional layer **27** may be quite thin and the material added may be diffused into the quartz. One such material is calcium oxide which gives a brilliant white light when heated to a temperature in the range of 1,500 to 4,000 degrees centigrade. Many other metal oxides such as sodium oxide, cerium oxide and thorium oxide, are available for deposition on the inside surface of the quartz cylinder. Some of these oxides produce a color which is predominate in other spectral emmission regions. By using quartz cylinders with different layers, a large range of color combinations is possible. It should be noted that while the quartz alone sublimes under continual application of high temperature flames, other oxides such as calcium and cobalt are more stable and resist sublimation. Layer **27** is deposited on the inner surface of the inner tube **28**.

Referring now to FIG. 5, the detailed construction of the lamp is shown. The inner quartz cylinder **28** is shown with a layer of added oxide material **27**. Surrounding this tube **28** is an outer tube **30**, also of fused quartz, which is designed to be a permanent transparent retaining tube. The inner tube **28**, because of the high temperatures applied to it may sublime or otherwise disintegrate and for this reason may require renewal after a number of active hours of service.

The exit end of the quartz tubes is surrounded by a block of metal **31**. An added liner **32** of tantalum tungsten alloy is mounted adjoining tube **28** and contains an

orifice **33** which permits the burned compounds to escape into the atmosphere. The copending application of common assignee herewith, Ser. No. 680,397, filed Nov. 3, 1967, entitled "Enhanced Output Light Source," by John C. Holme, discloses and claims, inter alia, certain features of an escape orifice such as orifice **33**, which are not here claimed and are no part of the instant invention. At the other end of the tube **28** a block **41** includes a mixing chamber **34** where the fuel and the oxidizer gases are mixed and then discharged into the interior of tube **28**. The mixing chamber **34** is connected by a first conduit **35** to a tank containing fuel fluid. A solenoid valve **36** is mounted in series with conduit **35** so as to open or close the supply line to the mixing chamber. In a similar manner, conduit **37** supplies the oxidizing gas to the mixing chamber in series with a solenoid operated fuel valve **38**.

The input terminal and the output terminal are mounted on either ends of the combustion tube **28** and may be clamped together by any suitable means such as bolts **40**. The mixing chamber and the valves **36**, **38** are all mounted in a recess in terminal block **41**. An expandable washer **44** of heat insulation is placed between the ends of the quartz cylinders and block **41**.

The operation of this type of light source is as follows: after being lowered from a helicopter, the valves **36** and **38** are opened by remote control and a mixture of inflammable gas is delivered to the combustion chamber defined by the inner-surface **27**. At this point current is applied to the high tension coil **42** and the spark electrode **43** and a spark jumps across the gap to ignite the combustible mixture in chamber **34**. This flame raises the temperature of the inside surface of tube **28** and causes the quartz cylinder to light up. If an inner layer **27** is used it also becomes incandescent. After heating the inner surface **27** to incandescence, the burned gases are ejected through the exit port **33**. This action provides a brilliant white light which may be applied to any large land area. When used alone without any storage tanks, the light source may be suspended by one or more cables **45**.

From the above description and drawings it will be evident that a simplified light source has been provided. In order to produce an incandescent temperature for lighting up the quartz or the added layer, the quartz may become soft and may be slightly deformed. The outer cylinder **30** is designed to supplement the inner cylinder and to act as a cooling member.

The foregoing disclosure and drawings are merely illustrative of the principles of this invention and are not to be interpreted in a limiting sense. The only limitations are to be determined from the scope of the appended claims.

We claim:

1. A light source comprising, a hollow cylindrical tube of fused quartz, a mixing chamber secured to one end of the tube for producing a combustible gas mixture, a first conduit connected to the mixing chamber for supplying fuel, a second conduit connected to the mixing chamber for supplying an oxidizing agent, an igniter means positioned to an output orifice of said mixing chamber for igniting the mixture of fuel and oxidizing agent, an exit orifice at the other end of the cylindrical tube for the elimination of the burnt gases, and a layer of a metallic oxide deposited on the inner surface of said cylindrical tube for increasing the spectral emissivity.

2. A light source as claimed in claim **1** wherein said layer is a substance selected from the group consisting of calcium oxide, thorium oxide, cerium oxide and sodium oxide.

3. A light source as claimed in claim **1** wherein said exit orifice is composed of an alloy of tantalum and tungsten.

4. A light source as claimed in claim **1** wherein said first and second conduits are each connected through remote controlled valves.

5. A light source as claimed in claim **1** wherein a second hollow fused quartz cylindrical tube is fitted over said tube for mechanical stability.

6. A light source as claimed in claim **5** wherein said quartz cylinders are clamped between two metal end pieces, one of which contains the mixing chamber and the other of which surrounds the exit orifice.

7. A light source, comprising: A combustion chamber of optically transparent refractory material; means for introducing and sustaining burning gases in an input region of said chamber; exhaust means at an exhaust region of said chamber for exhausting said burning gases; and matter which provides a greater magnitude of spectral emissivity in the visible region than in the invisible region when heated to temperatures provided by said sustained burning gases, said emissive matter located in the path of heat radiated by said gases and contiguous with a wall of said combustion chamber.

8. A light source as recited in claim **7** wherein said matter is deposited as a layer on the inner surface of said combustion chamber.

9. A light source as recited in claim **7** wherein said matter is diffused in the wall of said combustion chamber.

10. A light source as recited in claim **7** wherein said spectrally emissive matter is a metallic oxide.

11. A light source as recited in claim **7** wherein said combustion chamber is a tubular vessel of fused quartz.

12. A light source as recited in claim **7** wherein said spectrally emissive matter is a discrete emitter in the visible region of the spectrum.

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