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C. G. SUITS

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LIGHT SOURCE

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Fig. 1.

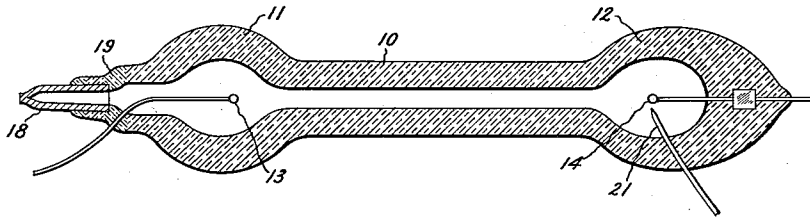
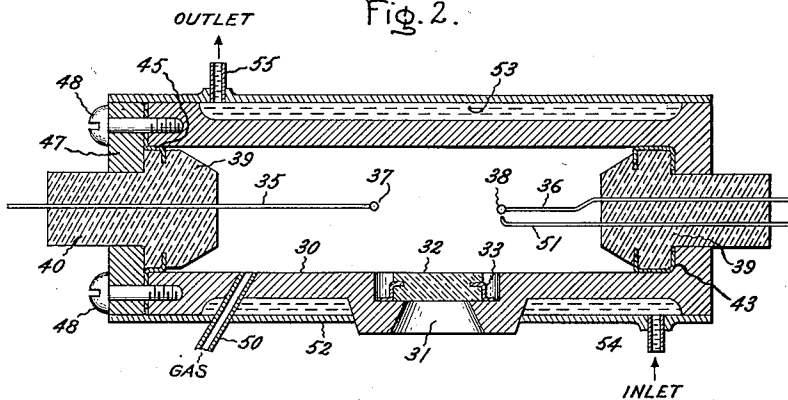


Fig. 2.



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LIGHT SOURCE

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3 Claims. (Cl. 176-122)

The present invention comprises an improved light source and has for its object the provision of a device of the luminous discharge type which is capable of highly efficient operation.

The aspects of the invention which I desire to protect herein are pointed out with particularity in the appended claims. The invention itself, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the drawing in which Figs. 1 and 2 are sectional views respectively representing alternative embodiments of the invention.

An understanding of the invention will be aided by consideration of the following table in which are listed the luminous efficiencies (in lumens per watt) which I have found to be obtainable with an arc discharge through various gaseous substances and over a fairly wide range of pressures.

Pressure	Helium	Argon	Nitrogen
1 atmosphere.....	0.4	0.4	2.3
10 atmospheres.....	0.85	3.0	3.1
30 atmospheres.....	1.3	7.3	10.7
50 atmospheres.....	1.7	10.7	17.0
100 atmospheres.....	2.5	17.0	27.0

From this table it will be seen that all of these gases have a luminous efficiency at atmospheric pressure which is so low as to make their use for light production impractical. I have discovered, however, that as the pressure is increased there is a sharp difference in their behavior. Thus, in the case of helium the efficiency is not markedly improved even at 100 atmospheres pressure, the indicated increase being only six fold, and the efficiency at this pressure still being so low as to be useless for general illumination purposes.

As contrasted with this, I have found that argon and nitrogen have a marked increase in efficiency as the pressure thereof is increased. Thus, in the case of argon, the luminous efficiency is increased more than forty fold when the pressure is increased to 100 atmospheres, and substantially equals the efficiency of the incandescent lamps which are in general use. The eleven fold increase in the luminous output obtained with 100 atmospheres of nitrogen results in an efficiency which very substantially exceeds that produced by incandescent sources. This sharp increase in efficiency with increased pressure to values which are practical for general illumination purposes makes these gases, argon and nitrogen, unique among the gases which

have been used to support gaseous discharges and was entirely unexpected in view of their low efficiency at the low pressures heretofore employed.

The discovery described in the foregoing may be utilized by employing either nitrogen or argon at a pressure of from thirty to several hundred atmospheres as an operating medium for an arc-type discharge in a light-transmitting container. A particular structure by which this may be done is illustrated in Fig. 1.

In the figure referred to there is shown an elongated envelope 10 which is preferably constituted of a light-permeable vitreous material such as fused quartz. It is provided at its ends with enlarged portions 11, 12 which respectively enclose aligned discharge electrodes 13, 14. These electrodes may appropriately consist of tungsten or an equivalent refractory metal.

In order that the operating gas may be introduced into the envelope 10 at the desired high pressure, the envelope is provided with a special tubulation 18. This is preferably constituted of a metal such as a nickel, iron, cobalt alloy which can be fused directly to glass. The tubulation is joined to the main body of the envelope by means of a graded glass seal whose presence is indicated by the variable cross-hatching applied at 19. I have found that a tubulation of the character described may be sealed off by welding even under pressures as high as several hundred atmospheres.

In order to facilitate the initiation of a discharge between the electrodes 13 and 14 there is provided a pointed auxiliary electrode 21 having its tip in close proximity to the electrode 14. By applying a relatively low voltage between the electrode 14 and 21, one may initiate an arc which readily transfers to the electrode 13.

Where it is desired to use pressures materially above thirty atmospheres, it is expedient to employ a construction of greater mechanical strength than that shown in Fig. 1. In this connection there is illustrated in Fig. 2 a discharge device, suitable for projection purposes, which comprises a heavy metallic envelope 30 which serves to confine the discharge space. This envelope is provided with an opening 31 which is occupied by a transparent window 32. The window may consist of glass or quartz and is hermetically sealed to the envelope wall by means of a flanged collar 33 having one edge thereof fused into the body of the window. The other edge of the collar 33 may be integrally fused to the surface of the envelope wall as by soldering or welding thereto.

At the ends of the envelope there are provided plugs 39 and 40 which serve to support lead-in conductors 35, 36 for supplying current to a pair of spaced electrodes 37, 38. Each of the plugs referred to is constituted of fusible vitreous material (e. g. glass) and is provided with a shaft portion which extends outwardly through the envelope wall. A gas-tight connection between the plug 39 and the end wall of the envelope is provided by means of a flanged collar 43 which is sealed at its respective edges to the plug and to the envelope. A functionally similar collar 45 is provided in connection with the plug 40. A clamping ring 47, which is secured to the envelope by means of bolts 48, protects the collar 45 from the shearing effects of the pressure existing within the envelope.

The electrodes 37 and 38 define a discharge path which is adjacent to the window 32. Consequently a discharge between them may be made to project its radiations on to an external object through the window. In order that the discharge referred to may be of high luminous efficiency, argon or nitrogen at high pressure (i. e. thirty to several hundred atmospheres) is introduced into the discharge space by means of a tubulation 50 which extends through the wall of the envelope 30. This tubulation may be permanently connected with a source of high pressure gas or may be sealed off after gas has once been introduced into the envelope interior. Where the tubulation is left open, it may in some cases be used advantageously to effect a temporary reduction in the gas pressure in the envelope to increase the ease of starting a discharge. An auxiliary electrode 51 is also provided for employment in this connection.

In order to protect the various parts of the device from the excessive temperatures developed during operation, an external cooling jacket is provided in connection with the outer surface of the envelope 30. This jacket is formed by means of a shell 52 which is somewhat spaced from the envelope so as to provide a chamber 53 for the circulation of cooling fluid. Such fluid may be passed through the chamber by means of appropriate inlet and outlet connections, indicated respectively at 54 and 55.

While I have in the foregoing referred to nitrogen and argon as being used alone, no departure from my invention would be involved in employing these gases together or in admixture with minor proportions of other gases such, for example, as neon. I, therefore, aim in the appended claims to include such alternative possibilities as those referred to.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A light source comprising a metallic container of relatively small cross-section in relation to its length, metallic end-walls closing the extremities of said container, and having re-

stricted openings therein, relatively massive bodies of vitreous material within the container and abutting against the said end-walls thereof, said bodies extending over substantially the entire cross-section of the container and being hermetically joined to the container, conductors extending through said end-wall openings and sealed through said bodies of vitreous material, spaced electrodes respectively supported by said conductors, an operating atmosphere for the electrodes comprising a light-producing gas at a pressure in excess of about thirty atmospheres, and a light-permeable window provided in the lateral wall of the container in position to permit passage therethrough of light generated by a discharge between said electrodes.

2. A light source comprising a metallic container of relatively small cross-section in relation to its length, electrodes within said container, metallic end-walls closing the extremities of said container, at least one of said end-walls having a restricted opening therein, a relatively massive body of vitreous material within the container and abutting against the said one of said end-walls, said body extending over a substantial portion of the entire cross-section of the container and having metallic means peripherally sealed thereto for hermetically joining the body to the wall of the container, a conductor extending through said end-wall opening and sealed through said body of vitreous material, said container being connected to one of said electrodes, an operating atmosphere within the container comprising a light-producing gas at a pressure in excess of about thirty atmospheres, and a light-permeable window provided in the lateral wall of the container in position to permit passage therethrough of light generated by a discharge between said electrodes.

3. A light source comprising a metallic container of relatively small cross-section in relation to its length, electrodes within said container, metallic end-walls closing the extremities of said container, at least one of said end-walls having an opening therein, a body of vitreous material within the container and abutting against the said one of said end-walls, an annular collar having an inner edge thereof embedded in said body and hermetically joined at its other edge to the wall of the container, a conductor extending through said end-wall opening and sealed through said body of vitreous material, said conductor being connected with one of said electrodes, an operating atmosphere within the container comprising a light-producing gas at a high pressure, and a light-permeable window provided in the wall of the container in position to permit passage therethrough of light generated by a discharge between said electrodes.

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