

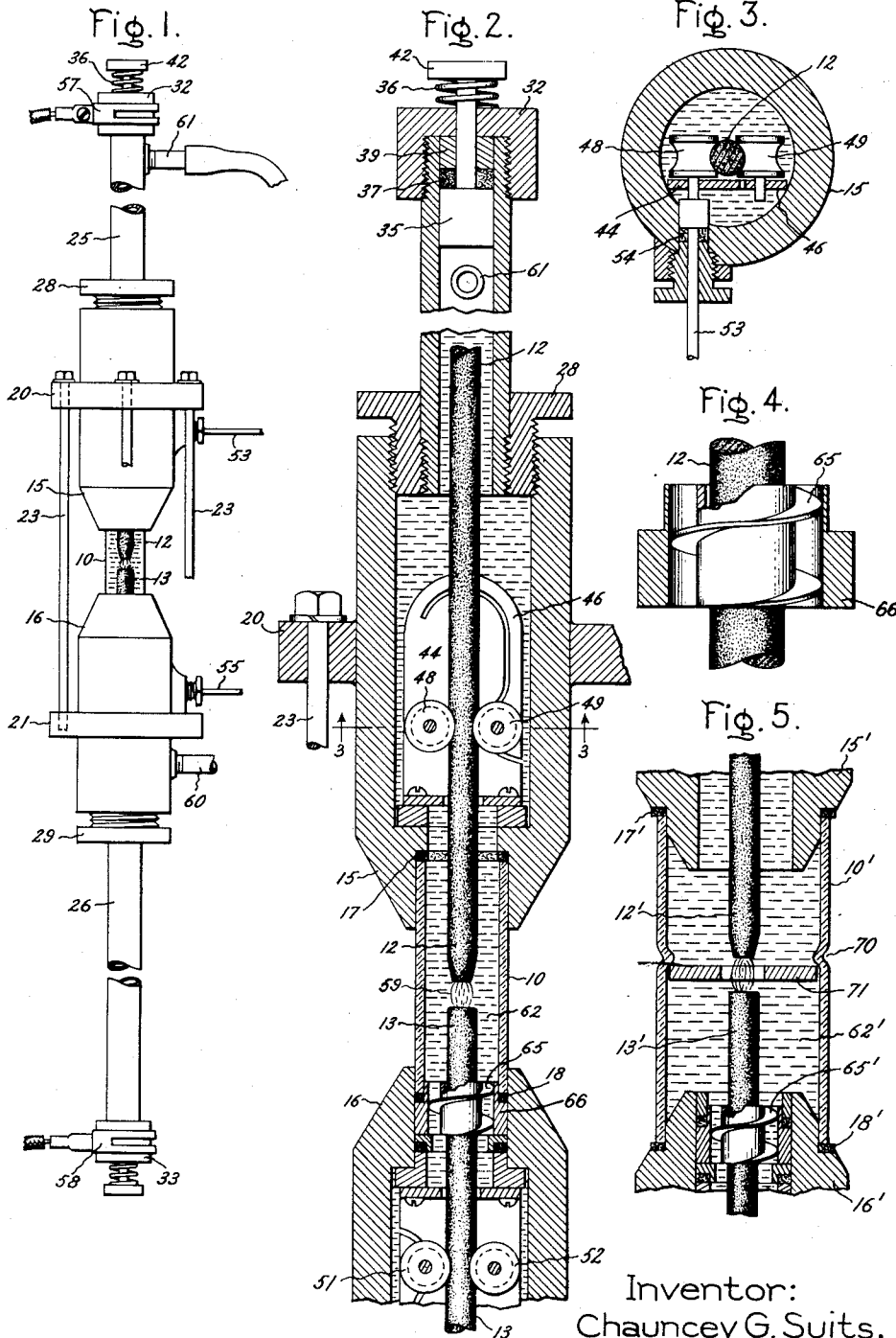
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C. G. SUITS

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HIGH INTENSITY LIGHT SOURCE

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Inventor:
Chauncey G. Suits,
by *Harry E. Simha*
His Attorney.

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HIGH INTENSITY LIGHT SOURCE

Chauncey G. Suits, Schenectady, N. Y., assignor
to General Electric Company, a corporation of
New York

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The present invention relates to an improved form of high intensity light source.

Considerable success has been attained in procuring high luminous intensities by means of an arc discharge operating in a high pressure gaseous atmosphere, one example of a light source of this kind being the quartz-enclosed mercury lamp with an operating pressure of several atmospheres. An ultimate limitation appears to be imposed on the intensities realizable with this type of lamp, however, by the tendency of the mercury discharge under extreme operating conditions to devitrify the quartz container and thus to destroy its light-transmitting quality and impair its strength.

It is an object of the present invention to provide a high pressure luminous arc source which is not subject to a limitation of this kind, and in this connection an important feature of the invention consists in the provision of means for maintaining a discharge in a vapor-filled space which is directly bounded by a liquid under pressure, preferably a pressure of at least several atmospheres. This is accomplished in a typical embodiment of the invention by circulating a suitable liquid, for example, water, about the inter-electrode space within which the discharge is established.

It is found that this procedure permits the creation of a highly concentrated arc having very great luminous intensity. Moreover, this is accomplished in a manner which affords very full protection to the container in which the discharge is established and prevents impairment of the container's light-transmitting quality even after a long period of operation of the apparatus.

A further feature of the invention comprises the use of means for continually circulating the high pressure fluid through the discharge container and for imparting rotary motion to the fluid as it passes the active portion of the arc. The first expedient assures the continuous removal of heat and of deleterious discharge products, while the second has the effect of stabilizing the discharge and of maintaining it in fixed relation with respect to the walls of the container.

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 Fig. 1 is a side elevation of an apparatus suitably embodying the invention; Fig. 2 is a longitudinal section of the oper-

ative parts of the apparatus of Fig. 1 (these parts being rotated 90° from the position which they occupy in Fig. 1; Fig. 3 is a sectional view taken on line 3—3 of Fig. 2; Fig. 4 is an enlarged view of certain of the elements of Fig. 2; and Fig. 5 is a sectional view illustrating a modification of the invention.

The light-emitting portion of the illustrated apparatus is that which is indicated at 10 in Figs. 1 and 2. This comprises a tubular member which consists of a light-transmitting substance, preferably quartz, and which encloses the mutually spaced extremities of discharge-sustaining electrodes 12 and 13. These electrodes may be of the solid carbon type, or, alternatively, they may be "cored carbons" of the general character described in E. A. Sperry Patent 1,227,210, granted May 22, 1917. In the latter case the core of the negative electrode should be of such character as to increase its electron emissivity, while the core of the positive electrode, or anode, may advantageously contain a material which is adapted to enhance the luminosity of the interelectrode discharge, for example, cerium oxide.

The quartz member 10 is supported at its ends by tapered cylindrical parts 15 and 16, the resulting joints being sealed by compressible gaskets indicated at 17 and 18. The parts 15 and 16 bear integral flanges 20 and 21 and are compressed against the ends of part 10 by means of a series of bolts 23 cooperating with these flanges.

Each of the parts 15 and 16 connects at its end with a smaller tubular member (25 and 26), the joints between these parts being formed by means of adapters 28 and 29. The parts 25 and 26 are made of sufficient length and internal dimensions so as readily to receive within them the inactive ends of the electrodes 12 and 13, these electrodes being initially introduced by means of removable closure elements 32 and 33 provided at the respective extremities of the parts 25 and 26. The construction of one of these closure elements is illustrated at the upper portion of Fig. 2 and is shown to include, in addition to the part 32, a piston 35 which is slidably supported in the part 32 and which is biased in the upward direction by means of a compression spring 36. As the piston 35 moves upwardly, either through the action of the spring 36 or under the influence of unbalanced pressure existing within the apparatus, it compresses a gasket member 37 which is confined between the piston and a cooperating element 39 surrounding the piston shaft. By this means a fluid-tight seal may be established, the quality of which tends to improve as the internal pres-

sure within the apparatus increases. When it is desired to remove the closure element 32 for the purpose of replacing the electrode 12, this may be readily accomplished by first applying pressure to the enlarged head 42 provided on the piston shaft and by this means moving the piston in a downward direction to relieve the closure member from the frictional restraint which would otherwise be imposed on it by the compressed gasket 37 and the element 39.

Within the member 15 the electrode 12 is supported by means of a bracket 44 which has as an integral part thereof a resilient arm 46. This arm supports one of two cooperating drive wheels 48 and 49 between which the electrode 12 is frictionally retained (see Fig. 3), the spring action of the arm 46 being sufficient to assure tight engagement of the electrode by the drive wheels. A similar pair of drive wheels 51 and 52, similarly mounted, support the electrode 13. The wheel 48 may be positively driven by means of an externally accessible drive shaft 53 which is sealed through the wall of the container part 15 by the use of a packing gland indicated at 54, and a similar drive shaft 55 is provided in connection with the wheel 52. By rotation of the shafts 53 and 55 it is possible to move the electrodes 12 and 13 longitudinally and by this action to control their relative positions. During use of the apparatus, the position and feeding of the electrode may be automatically regulated by any appropriate mechanism such, for example, as that which is disclosed in Heinrich Beck Patent 1,313,666, granted August 19, 1919.

In the operation of the apparatus, unidirectional potential is applied between the electrodes 12 and 13 by means of terminal connections indicated at 57 and 58, the circuit to the electrodes being completed through the metallic structure of the mounting brackets and drive wheels described above. The polarity of the applied potential should be such as to make the electrode 12 a cathode and the electrode 13 an anode. In order to initiate operation, the electrodes may be brought into momentary contact and then drawn apart to establish a discharge between them. It is this discharge (indicated at 59) which is responsible for the light emission of the apparatus.

In order that the discharge between the electrodes 12 and 13 may be converted into a highly intense luminous arc, there is provided about the arc-containing space a continuous sheath 62 of liquid under pressure. To this end the container part 16 is provided with a fluid inlet connection 60, and a corresponding outlet connection 61 is provided in conjunction with the part 25. The liquid supply may comprise, for example, a tank of water (not shown) which is maintained under a pressure of from fifty to several hundred pounds per square inch. For reasons which will be explained shortly, it is preferred to cause the high pressure liquid to be continuously circulated through the discharge chamber, a thing which can be readily done by connecting a suitable pumping arrangement (not shown) in circuit between the liquid supply tank and the fluid conduits 60 and 61.

With the provisions described above, and utilizing water as the high pressure fluid, an arc discharge of very intense character may be maintained between the electrodes 12 and 13, the discharge taking place in a space, or bubble, filled with steam and with the hydrogen and carbon monoxide generated by the progressive dissociation of water vapor in contact with the carbon

electrodes. The fact that a continuous sheath of water exists between the arc and the vitreous container 10 fully protects the container from deterioration due to excessive heat and from other destructive effects of the arc. Moreover, the continuous motion of the fluid as it is circulated through the apparatus permits the removal of products of the discharge which might otherwise tend to obscure the arc and to lessen the emission of light. It is found that with a liquid pressure of 100 pounds or more a light intensity on the order of one million lumens or better can be realized.

It is, of course, desirable that the arc be confined to the central region of the discharge chamber, and in this connection it is helpful to provide means for producing rotary motion of the circulating liquid as it passes the region within which the arc exists. This may conveniently be done in one way by the use of a spiral baffle or vane structure 65 (see Fig. 4) at the entrance end of the arc chamber. This structure, which is mounted in a conforming sleeve 66, has the effect of imparting a whirling motion to the liquid as it passes upwardly through the structure, which motion continues as the liquid proceeds through the enclosure 10 and past the discharge space. This expedient is found very effective in preventing the arc discharge from coming into contact with the surface of the transparent container part 10.

A still further alternative, and for some applications an improvement, in the matter of confining the arc discharge comprises the modified construction which is illustrated in Fig. 5, in which elements corresponding to parts previously described bear similar numerals, differentiated by priming. In this case the discharge chamber is provided within a cylindrical glass member 10' which is clamped between the tapered extremities of cooperating metallic parts 15' and 16'. At its central portion the member 10' is provided with an inwardly directed indentation 70 which serves as an abutment for a disk 71 having a central opening 72 through which a discharge between electrodes 12' and 13' may pass and through which the high pressure liquid 62' may flow. The disk 71 is of a highly refractive substance such as asbestos lumber and has the effect of fixedly centering the arc discharge. Its effectiveness in this respect may be further augmented, if desired, by the provision of a helical baffle 65' having the purpose and function of the correspondingly numbered element described in connection with Fig. 2.

While water is considered to be the preferred liquid for the purposes of the present invention because it has no objectionable solid products of dissociation and because the vapors produced when it dissociates in contact with carbon are adapted to sustain an arc of good luminous quality, other liquids may obviously be employed. For example, one may use in this connection a substance such as glycerine.

Moreover, although the invention has been described by reference to a particular structural embodiment, it will be understood that numerous modifications may be made by those skilled in the art. I, therefore, aim to cover in the appended claims all variations of structure or of materials which are within the true spirit and scope of the foregoing disclosure.

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

1. A high intensity light source comprising mutually spaced electrodes providing a discharge

path between them and a liquid under a pressure of at least several atmospheres disposed about and in contiguity with the said discharge path, whereby an arc occurring between the said electrodes is caused to exist in a vapor-filled space bounded directly by the said liquid.

2. The method of generating light by means of an arc discharge between mutually spaced electrodes which comprises passing a discharge current between the electrodes while the discharge space is enclosed in a sheath of liquid under a pressure of from fifty to several hundred pounds per square inch and in direct contiguity with the resultant arc.

3. A light source comprising a container having a light-transmitting wall part, mutually spaced electrodes within the container and providing a discharge path in proximity to the said wall part, and a liquid under pressure of at least several atmospheres within the container and disposed about the said discharge path, whereby an arc occurring between the said electrodes is caused to exist in a vapor-filled space bounded directly by the said liquid.

4. A high intensity light source comprising a container having a light-transmitting wall part, mutually spaced electrodes within the container and providing a discharge path in proximity to the said wall part, and means for circulating a liquid under pressure through the container and about the said discharge path, whereby an arc discharge passing between the said electrodes is caused to exist in a vapor-filled space bounded directly by the said liquid.

5. A high intensity light source comprising a container which consists at least in part of a hollow tubular member of light-transmitting character, spaced electrodes within the container and providing a discharge path within the said

hollow tubular member, and means for circulating a liquid under pressure through the said tubular member in direct contiguity with the space defining the discharge path.

6. A high intensity light source comprising a container having a light-transmitting wall part, mutually spaced electrodes within the container and providing a discharge path in proximity to the said wall part, means for introducing a liquid under pressure into the said container and for circulating the liquid with a rotary motion about the said discharge path, whereby an arc discharge passing between the said electrodes is confined to a vapor-filled space bounded directly by the said liquid.

7. A light source comprising a container having a light-transmitting wall part, means including spaced electrodes within the container for establishing an arc discharge in proximity to the said wall part, means for circulating a liquid under pressure through the container and in direct contiguity with the said discharge, and means including a helical vane system positioned to impart rotary motion to the liquid as it passes the interelectrode space within which the arc discharge occurs.

8. A light source comprising a container having a light-transmitting part, spaced electrodes within the container for establishing a luminous arc discharge in proximity to the said part, a member positioned transversely to the discharge path and having a restricted opening through which the discharge passes, thereby to stabilize the discharge, and means for circulating a liquid under pressure through the container and through the said opening, whereby the region within which the discharge occurs comprises a vapor-filled space bounded directly by the liquid.

CHAUNCEY G. SUTTS.