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ELECTRICAL DISCHARGE DEVICE

Filed April 10, 1922

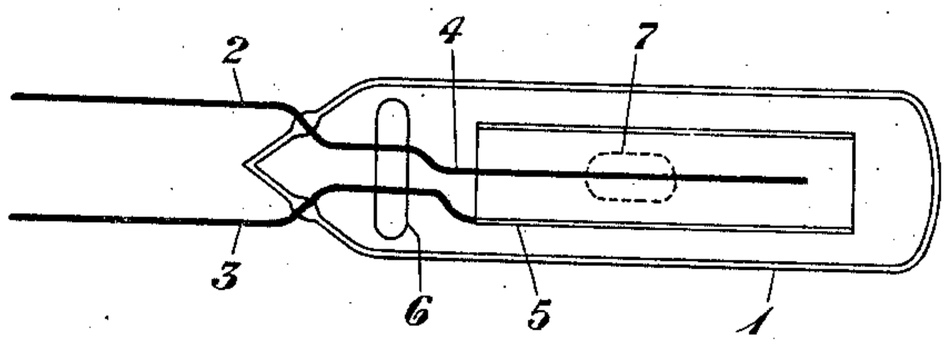

Fig. 1

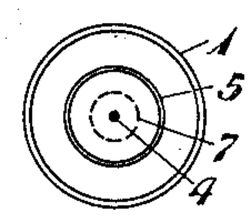

Fig. 1a

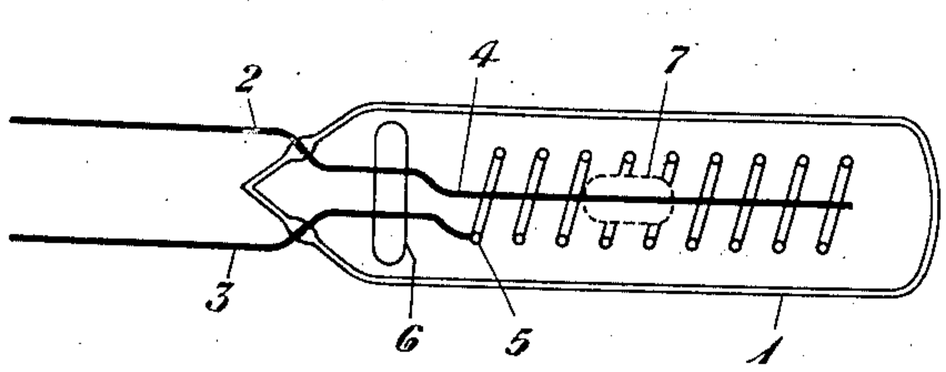

Fig. 2

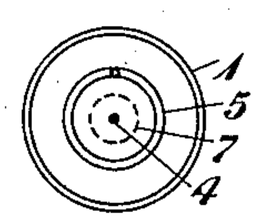

Fig. 2a

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UNITED STATES PATENT OFFICE.

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ELECTRICAL DISCHARGE DEVICE.

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This invention relates broadly to electrical discharge devices and particularly to an electric lamp designed for signaling purposes, as, for example, in telephone switchboards.

Electric lamps based upon the principle of discharge between cold electrodes in a glass envelope or bulb filled with an inert gas such as neon, helium, argon, etc., are well known to those familiar with the art. Such lamps are in general made by two processes—one which may be designated the all-glass process, and the other designated as a modification of the ordinary bench-exhaust system.

In the all-glass process, the glass bulbs into which the electrodes have been sealed are welded to the glass tubes to which are also connected a vacuum pump and a container of the inert gas with which the lamp bulbs are to be filled. After the air has been exhausted from the lamp bulb by means of the air pump connected with the glass tubes of the all-glass system, the pumping is discontinued and gas is allowed to flow through the said tubes from the gas container into the lamp bulbs, until the said bulbs are filled with gas at the desired pressure. The lamp bulb is then sealed off in a manner well known in the art of manufacture of glass lamps. It will be seen that in such a process, if the lamp bulb has been carefully welded to the tubes of the all-glass system, air will not enter the bulb after the pumping has been discontinued and during the time of filling the bulb with the inert gas. This process results in lamps of high quality, but, as will be apparent, it is costly of operation in view of the time necessary to seal each of the individual lamp bulbs to the glass tubes of the all-glass system. In addition, the maintenance cost of the all-glass system is expensive, and furthermore, there is always present the possible loss of the expensive gas through accidental breakage of the system.

The second process, utilizing the usual brass manifold and piping, joined by rubber tubing, is designed to reduce the cost of production of such lamps by eliminating the step of welding the glass bulbs to the all-glass system. In the second process, the individual bulbs which are to be exhausted and filled with the inert gas, are attached to the brass exhaust manifold by means of a flexible rubber connection, which readily permits of the replacements of the lamp bulbs after the preceding exhausted ones have been sealed off. The glass neon container and suitable glass stopcocks are joined to the manifold through a rubber connection, and this, the only glass part of the system, can be readily protected from breakage. It will be seen that in such a system there is a varying degree of leakage around such rubber connections, so that after the pumping ceases, air mixes with the inert gas with which the lamp bulbs are filled.

The presence of residual air in such bulbs prevents the operation of the lamp at the desired voltage, and it is important to provide means for eliminating it. Various means are provided for effecting the desired result. One of these consists in giving the lamp, after it has been sealed off, a so-called seasoning or flashing treatment which vaporizes a suitable chemical called a "getter", which removes the impurities in the gas by forming compounds of very low vapor pressure. These compounds are deposited mainly on the walls of the lamp and leave the inert gas in a condition of high purity. Various elements have been used as a "getter", such for example, as metallic magnesium or calcium, which is spot-welded to one or both of the electrodes. A high potential is then applied to the electrodes, and a discharge takes place from the "getter" to the other electrode, because of the lower cathode fall between the "getter" and the surrounding gas. The combination of the "getter" with the oxygen and the other active elements of the air results in a gray-black, silvery, or almost opaque deposit on the glass bulb, which renders such lamps unsatisfactory, if not, useless. In certain forms of lamps, such for example, as those used in spark-plug testing devices, the electrodes are placed in opposite ends of a relatively long tube, the central portion of which is considerably attenuated. This, in effect, confines the cloudy deposit to the ends of the tube, and leaves the central portion clear, so that the discharge through the inert gas, which occurs in normal operation, may be readily observed through the glass walls of the central part of the tube. This method can not be carried out in lamps which are designed to operate at relatively low voltage,

such for example, as the ringing voltage used with telephone signaling lines, because the electrodes in such a lamp need be placed in relatively close juxtaposition.

One of the objects of this invention is to produce a lamp operating upon the principle of discharge through an inert gas, the walls of the said lamp being substantially free from cloudiness resulting from the combination of the "getter" with any active element of the air that may be present therein.

Another object is to provide a lamp of the character described, in which one of the electrodes substantially surrounds the other electrode, so that the discharge between the said electrodes takes place in a region almost entirely surrounded by metal, whereby the absorption of the inert gas by the glass walls is less than in lamps where the discharge is near the glass walls of the bulb, thereby increasing the life of such lamps.

A further object of my invention is to provide a lamp for use in signaling as, for example, in telephone switchboards, in which the desired color of the lamp may be produced by the electrical discharge through a selected inert gas which produces a glow having the distinctive color desired.

This invention will be better understood from the following description, when read in connection with the attached drawing, of which Figure 1 shows a longitudinal cross section of a preferred form of embodiment of my invention; Fig. 1ª shows an end view of the same; Fig. 2 shows a longitudinal cross section of an alternative form of the invention, and Fig. 2ª, an end view of Fig. 2.

In Fig. 1, 1 represents the glass bulb or receptacle into which have been placed and sealed the connecting wires 2 and 3, which are connected within the bulb with the electrodes 4 and 5. The leading-in wires 2 and 3 are held together by means of a glass bead 6, which tends to strengthen the structure, and also tends to prevent the discharge from taking place elsewhere than between the electrodes 4 and 5. The electrode 4 may be of the form of a solid cylinder or any other suitable form. The electrode 5 consists of a hollow cylinder which preferably is designed to entirely surround the electrode 4, thereby confining the discharge substantially to the space between the two electrodes. Attached to the electrode 4, by welding or other suitable means, is a piece of magnesium, calcium, or other suitable material, designated as the "getter", the function of which is to remove the active elements of air that may be present in the bulb after it has been sealed off. When the lamp has been sealed off, after being filled with the inert gas, which, as heretofore stated, may contain a certain amount of air due to leakage of the system, or to any other cause, the wires 2 and 3 are connected with a source of high potential and a discharge takes place between the "getter" 7 and the other electrode, which, in the case of the lamp shown in Fig. 1, is the cylinder 5. When the discharge takes place the "getter" vaporizes and combines with the active elements of the air, such as oxygen, nitrogen, etc., forming certain compounds, which, were it not for the presence of the cylindrical electrode 5, would be deposited on the inner surface of the bulb 1, thereby discoloring the bulb. However, due to the presence of the cold cylindrical electrode around the other electrode, to which the "getter" is attached, the compounds formed by the union of the "getter" with the said elements of the air, are deposited upon the inner surface of the cylindrical electrode 5, thereby keeping the walls of the bulb 1 substantially free from any deposit.

After the "getter" has been vaporized, the electrical discharge through the inert gas will take place between the electrode 4 and the cylindrical electrode 5. This discharge, when viewed from the end of the lamp, as shown in Fig. 1ª, will appear as a glow within the cylinder 5. Although the area of a cross-section through which the discharge takes place, as shown in Fig. 1ª, is not very large, the glow is quite intense, due to the depth of the cylinder 5, thereby rendering this type of lamp readily adapted for such use, as in telephone switchboards, where only the end of the lamp, as shown in Fig. 1ª, is visible. It will be seen, therefore, that by means of my invention, a lamp may be produced in which the walls are not darkened, or otherwise similarly affected, so that the emission of light from the end of the bulb is not obscured, and also in which the electrodes may be placed sufficiently close together to be operated, for example, by the normal ringing potential of 110 volts, or other low voltage.

A further advantage of the construction, in which the outer electrode is a concentric cylinder surrounding the other electrode, is that the discharge takes place in a region almost entirely surrounded by metal, so that the absorption of the inert gas by the glass walls of the bulb is much less than in lamps heretofore designed, in which the discharge takes place near the glass walls, thereby prolonging the life of the lamp.

Another form of the lamp is shown in longitudinal cross-section in Fig. 2, an end view of which is shown in Fig. 2ª. In these figures, parts similar to those in the foregoing figures have been given the same designating numerals. The arrangement shown in Fig. 2 differs from that shown in Fig. 1 in that the outer electrode consists of a helix instead of a hollow cylinder. While this form possesses certain advantages over that shown

in Fig. 1, as for example, cheapness of production, it is not believed to be as desirable a form as that shown in Fig. 1, because the compounds resulting from the combination of the "getter" with the air can pass through the spaces between the adjacent convolutions of the helix, and reach the inner walls of the glass bulb. It will be apparent, however, that if the "getter" is not too large in quantity and is localized at a point near the middle of the inner electrode, the end of the bulb will still be protected against the emission from the "getter", so that we get the result that is desired in a telephone switchboard lamp, namely, clearness of the end wall, and the concentration of the discharge through the inert gas between the two electrodes, which tends to diminish absorption.

Another feature of my invention consists in the utilization, in a lamp intended, for example, to be used in telephone switchboards, of various inert gases, either singly or in combination, in order to produce glows of different colors, thereby serving the same function which is now performed by a switchboard lamp of the incandescent type, covered by a colored lamp cap. Thus, for example, by using neon as the inert gas, a lamp producing a reddish glow may be obtained. By the addition of a trace of mercury, a bluish glow may be produced in lamps of this type. The use of argon or helium as the inert gas produces a blue or a yellow-white glow, respectively. Accordingly it is practicable to obtain a fairly wide range of colors or shades of color by using various inert gases in lamps of the electrical discharge type which are intended for signaling purposes, such as in telephone switchboards. Although the fact that certain inert gases produce characteristic colors of glow in electrical discharge devices is probably old, I claim as a new invention the application of the principle in a novel way to produce a new and useful result not heretofore contemplated or disclosed in the art. By the use of such lamps it is possible to supplant not only the clear-glass incandescent lamps with their colored lamp-caps, but also lamps in which the coloring material is worked into the walls of the glass bulb, both of which forms of lamps were expensive and of low lighting efficiency.

It will be seen, therefore, that in accordance with the principles of my invention, a lamp of the desired color may be produced which is well adapted for use in signaling service, such, for example, as in telephone switchboards, which can be manufactured more cheaply than the present incandescent lamp, which performs the same function as is now performed by such a lamp and its colored lamp cap, which is adapted to operate at the normal signaling potential now used, and which is free from the discoloration which heretofore characterized gas-filled lamps previously used.

Although this invention has been disclosed as being embodied in a certain form and arrangement of parts, it is to be understood that it is capable of embodiment in other and different forms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a lamp characterized by the discharge of electricity through gases, the combination with a transparent gas-tight envelope filled with inert gas and having an active gas also present, of a plurality of normally cold electrodes, and means affixed to one of the said electrodes and activated by the discharge between the said electrodes to change the said active gas to inactive chemical combinations, one of the said electrodes substantially surrounding the other electrode to substantially prevent discoloration of the transparent envelope by the said chemical combinations.

2. In a lamp characterized by the discharge of electricity through gases, the combination with a transparent gas-tight envelope containing neon gas at a predetermined pressure and having a trace of air present, of two normally cold electrodes, and means associated with said electrodes to produce a chemical change upon the contained air, one of the said electrodes substantially surrounding the other as to effectually shield the said envelope against the products of the said chemical combination, whereby clouding of the walls of the envelope is prevented.

3. In a device characterized by the discharge of electricity through gases, the combination with a gas-tight envelope, a part of which at least is transparent, containing inert and active gases, of a plurality of electrodes one of which effectively surrounds the other, a getter, interposed between the said electrodes and activated by the discharge therebetween to substantially prevent the deposit upon the transparent part of the envelope of compounds formed by the getter with the said active gas.

4. In a lamp characterized by the discharge of electricity through gases, the combination with a transparent gas-tight envelope containing inert gas and an active gas at a predetermined pressure, of a plurality of cold electrodes, and means activated by the discharge between the said electrodes to change the active gas into inactive chemical compounds, the said envelope being protected by one of the said electrodes against discoloration resulting from the discharge between the electrodes.

In testimony whereof, I have signed my name to this specification this 8th day of April, 1922.

WILLIAM H. T. HOLDEN.