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F. G. BACK

2,391,611

ILLUMINATING ARRANGEMENT

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Fig. 1

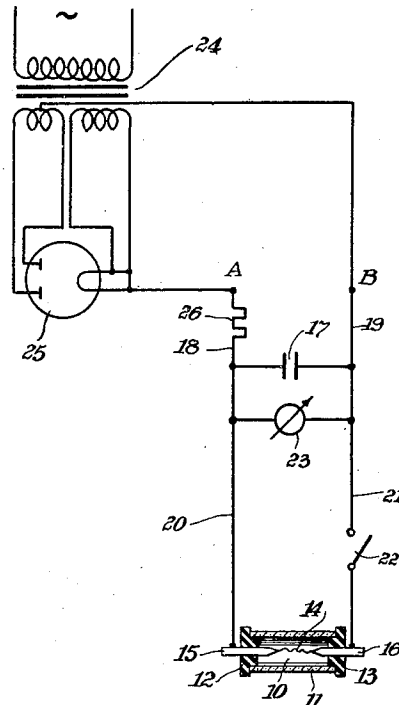


Fig. 2

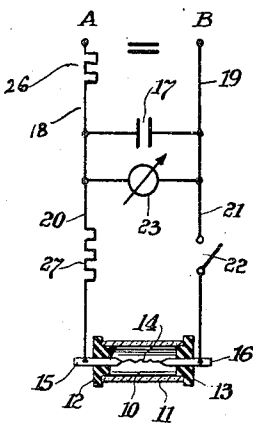


Fig. 3

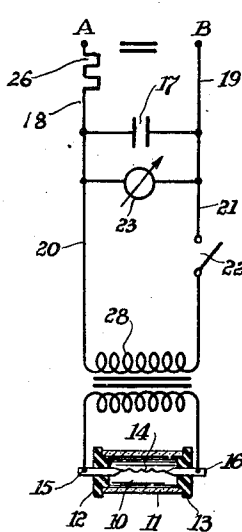
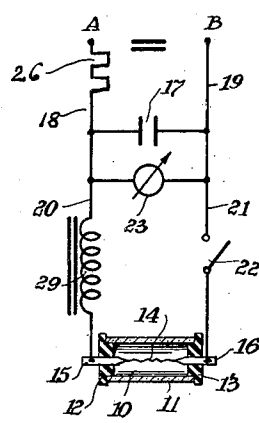


Fig. 4



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ILLUMINATING ARRANGEMENT

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2 Claims. (Cl. 315—353)

The present application is a continuation in part of my U. S. patent application 473,925 filed January 29, 1943, for "Electrical apparatus."

My present invention relates to improvements in illuminating arrangements for taking photographs, particularly color photographs, of cavities of the body, and more particularly to electrical apparatus for use for the momentary generation of high power electrical impulses for operating lighting devices for photographic purposes of the type stated above, particularly for operating lighting devices of the type used for photographic apparatus described and shown in my U. S. Letters Patent No. 2,349,932, issued May 30, 1944.

It is an object of the present invention to provide an electrical apparatus which makes the lighting device substantially independent from current and voltage variations of the electric supply circuit.

It is a further object of my present invention to provide a new combination of electrical devices capable of generating momentarily a difference in potential across two terminals, without the use of moving parts.

Still another object of my present invention consists in the provision of means extending the lighting period of the lighting device supplied by my new electrical apparatus, thereby also prolonging the exposure time of the photographic apparatus of which this lighting device forms a part.

Still a further object of my present invention consists in adjusting the electrical characteristics of the various parts and elements of my new illuminating arrangement in such a manner as to enable taking of satisfactory color photographs of cavities of the body.

With the above objects in view, my present invention mainly consists in an electrical apparatus comprising in combination a source of direct current, an electrical condenser, a switch, the lighting device of the photographic apparatus, and an electric circuit including this current source, condenser, switch, and lighting device. The condenser is connected with the source of current in such a manner as to be charged by the same when required, and the lighting device is connected across the terminals of the condenser; the switch is included in one of the leads connecting the condenser with the lighting device.

Use of an electrical condenser makes the lighting device substantially independent from variations in the electrical supply circuit, i. e., independent from voltage or current variations of the

above mentioned source of direct current. The new electrical apparatus proposed by me works by charging the condenser during inoperative periods of the lighting device and discharge of the condenser by closing the circuit by means of the switch whenever the lighting device has to be operated.

Although electrical apparatus of the above type are very well adapted for the purposes of the present invention, I have found that the discharge period and thus the period of lighting of the lighting device and exposure time of the photographic apparatus is extremely short. This has disadvantages for certain purposes. Therefore, I propose to include in my new electrical apparatus means for extending the discharge period of the electrical condenser operating the lighting device. These means might be the most different ones: thus, I might use an electrical resistor or a step down transformer, arranged between condenser and lighting device. Although these devices serve their purpose, i. e., prolong the discharge period of the condenser, they also involve loss of electrical energy, thereby reducing the intensity of light obtainable with the lighting device.

I have found that these side effects might be avoided by using as means for extending the discharge period of the condenser an electrical reactor included between condenser and lighting device. Inclusion of such an electrical reactor is adapted to extend the discharge period and thereby to prolong the lighting period of the lighting device without any loss in lighting intensity.

The only side effect which might be caused by use of an electrical reactor as means for extending the discharge period of the condenser is that it might cause high frequency oscillations between the step up transformer usually employed for creating the necessary direct current of sufficient energy and the reactor. Such oscillations might cause a short circuit within the condenser. In order to avoid this danger, I propose to use a condenser which has also the effect of an electric valve. Condensers having such an effect are electrolytic condensers, particularly dry electrolytic condensers which might be charged in one direction only. Naturally, it is essential to use a reactor which has a reactance great enough to slow up the current inrush during discharge of the condenser; the reactor also has to have a negligible resistance in order to avoid any reduction of efficiency of the apparatus.

I have found also that in case lighting devices provided with a filament which is vaporized by a current having a high discharge voltage are used, it is rather difficult to obtain an electric arc emitting light having characteristics satisfactory for taking color photographs. I have found that in order to obtain such color photographs, it is necessary for the arc to have a temperature of about 7300° Calvin, since otherwise it is impossible to obtain color photographs having the correct light and color values.

In accordance with my invention, therefore, I propose to adjust the electric characteristics of all parts and elements of my illuminating arrangement in such a manner as to obtain the required temperature of the illuminating arc and thus be able to take color photographs with the required color tones and brilliance. Preferably, the source of current has a predetermined initial voltage and the condenser has a predetermined capacity, while the electrical characteristics of the means for prolonging the discharge period, e. g., the resistance of the resistor or the impedance of the reactor used for these purposes are adjusted in such a manner that the momentary arc of high light intensity caused by vaporization of the filament in the lighting device has a temperature of about 7300° Calvin.

In this connection, I have found that the temperature of the filament of the lighting device of an illuminating arrangement according to my present invention increases when the voltage of the source of current and/or the capacity of the condenser increases and when the resistance of the resistor and/or the impedance of the reactor used for prolonging the discharge period decreases. On the contrary, the temperature decreases proportional to decrease of the voltage of the current and/or capacity of the condenser and proportional to increase of the resistance of the resistor and/or impedance of the reactor.

The novel features which I consider characteristic for my invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments, when read in connection with the accompanying drawing, in which:

Figure 1 shows an electrical circuit diagram according to the present invention with an electrical condenser but without means for retarding discharge of this condenser;

Figure 2 shows a modified electrical circuit diagram similar to the one shown in Fig. 1 with an electrical resistor for retarding discharge of the condenser;

Figure 3 shows a modified electrical circuit diagram similar to the one shown in Figure 2 with a step down transformer for the same purpose; and

Figure 4 also shows a modified electrical circuit diagram similar to the diagrams shown in Figs. 2 and 3 with an electrical reactor for this purpose.

As shown in Figure 1, the electrical apparatus serves for operating the lighting device 10. This device comprises a glass tube 11, caps 12 and 13 in each end of the tube, the filament or wire 14 within the tube being held in place in the caps 12 and 13 by the electrodes 15 and 16 which, as illustrated, are tapered and frictionally hold the filament in place. This lighting device is capable of momentary operation only, as the tungsten filament 14 is vaporized by increase of a difference

in potential across the electrodes 15 and 16; the metallic vapor created by this vaporization is then carrying the charge across electrodes 15 and 16, producing a blue or bluish white glow or flash particularly well adapted for photographic purposes. For creating this increase in potential, I provide condenser 17 which is connected to a source of direct current indicated by terminals A and B by means of leads 18 and 19 and to the electrodes 15 and 16 by means of leads 20 and 21. Switch 22 is included in the connecting lead 21 and causes discharge of condenser 17 across electrodes 15 and 16 and the lighting filament 14. An electrical measuring instrument 23 is connected across the terminals of condenser 17 as shown in the figure.

This apparatus is operated by first charging condenser 17 and then discharging it across the lighting device by closing switch 22, thereby vaporizing filament 14 and causing an intense glow within tube 11 as described above.

If there is a source of direct current available, the electrical energy for charging condenser 17 may be taken directly from the same. However, if there is only a source of alternating current, I may use the step up transformer 24 and the full wave rectifier tube 25 for creating a direct current of necessary intensity. In order to protect condenser 17, it is advantageous to provide in connection 18 resistor 26 between rectifier tube 25 and the condenser.

While I have not shown in the embodiment shown in Figure 1 any means for extending the discharge period of condenser 17, such means might be advantageous. Circuits embodying such means are shown in Figures 2 to 4. The circuits shown in these figures differ from the circuit shown in Figure 1 only by inclusion of resistor 27 in connection 20 (Figure 2), by arrangement of a step down transformer 28 between condenser 17 and lighting device 10 (Figure 3) and by inclusion of an electrical reactor 29 in connection 20 (Figure 4). All these means have the same effect, namely prolongation of the discharge period of condenser 17; however, as mentioned above, resistor 27 needs substantial electrical energy and the step down transformer 28 is of relatively large dimensions and necessitates provision of switch 22 in the primary circuit of the transformer; thus, both these embodiments are not particularly advantageous for the specific purposes of the present invention, i. e., for use in combination with apparatus for photographing cavities of the body of the type shown and described in my above mentioned United States patent.

The last shown embodiment, namely the one shown in Figure 4, has none of these disadvantages, and is therefore best adapted for the purposes of the present invention. However, it is advisable to use in this case an electrolytic condenser, preferably a dry electrolytic condenser, in order to avoid oscillations between reactor 29 and transformer 24.

As stated above, the electrical characteristics of the various elements of the illuminating arrangement, i. e., of the electrical circuit described above, have to be adjusted in such a way that the temperature of the electrical arc caused by vaporization of the metallic filament 14 is about 7300° Calvin. For this purpose, the voltage of the direct current supplied by the combined transformer 24 and rectifier 25, the capacity of the condenser 17, the resistance of the resistor 27, and the impedance of the reactor 29 have to

be adjusted in such a manner as to obtain the required temperature of the electric arc caused by vaporization of filament 14, i. e., a temperature of about 7300° Calvin. This adjustment is preferably carried out in such a way that some of the above listed electric characteristics have predetermined values, e. g., the voltage of the source of current and/or the capacity of the condenser 17, and that only the electrical characteristics of the elements for prolonging the discharge period, i. e., the resistance of resistor 27 and/or the impedance of the reactor 29 are adjusted so as to obtain in combination with the other predetermined electrical characteristics the required temperature.

It should be mentioned that the light source used in the illuminating arrangement proposed herewith has certain characteristics which have to be taken into account when color photographs are taken: namely, the illumination created by the lighting device 10 is caused partly by vaporization of the filament or wire 14 and partly by the glow of the gas created by such vaporization. While during vaporization of the filament the emitted light is substantially red and contains also light of other wave length, i. e., has a substantially continuous spectrum, the glowing gas consists of blue parts of the spectrum only.

As for obtaining proper color photographs, light having continuous spectrum is necessary, very short discharge periods of condenser 17 are unsatisfactory, since they result in extremely quick vaporization of the filament and thus a lack of red light rays in the light emitted by the lighting device 10. By providing discharge prolonging means, e. g., a reactor 29 or a resistance 27, it is possible on the one hand to prolong the glowing period of filament 14 during its vaporization and thereby to increase the red and continuous spectrum parts of the emitted light and on the other hand to shorten the glowing period of the gas created by vaporization of filament 14 and thereby to decrease proportion of the blue light emitted by the lighting device.

Thus, means for prolonging the discharge period of condenser 17 are of great help in obtaining the necessary spectral composition of the light emitted by the light source 10 of the type used, namely, a light source the light emission of which is composed of a glowing period of filament 14 during its vaporization and a following glowing period of the gas created by vaporization of filament 14.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of electrical apparatus differing from the types described above.

While I have illustrated and described the in-

vention as embodied in electrical circuits for lighting devices for photographic apparatus, I do not intend to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of my invention.

Without further analysis, the foregoing will so fully reveal the gist of my invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and therefore such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What I claim as new and desire to secure by Letters Patent is:

1. An illuminating device for taking color photographs of cavities of the body comprising in combination a source of direct current, a dry electrolytic condenser connected across said source of direct current by two connections, an electrical resistor included in one of said connections between said dry electrolytic condenser and said source of direct current, a lighting device provided with a vaporizable flash filament, said lighting device being connected across the terminals of said dry electrolytic condenser, an electrical reactor included in one of the connections between said dry electrolytic condenser and said lighting device, and a switch included in one of the connections between said dry electrolytic condenser and said lighting device.
2. An illuminating device for taking color photographs of cavities of the body comprising in combination, a source of alternating current, a step-up transformer combined with electric rectifying means and connected with said source of alternating current, a dry electrolytic condenser connected to said combined step-up transformer and rectifying means by two connections, an electric resistor included in one of said connections between said dry electrolytic condenser and said combined step-up transformer and rectifying means, a vaporizable metallic filament the ends of which are connected with said dry electrolytic condenser, means for prolonging the discharge period of said dry electrolytic condenser included in one of the connections between said dry electrolytic condenser and one end of said vaporizable metallic filament, and a switch included in one of the connections between said dry electrolytic condenser and one end of said vaporizable metallic filament enabling discharge of said dry electrolytic condenser through said metallic filament and vaporization of the same.

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