Oct. 7, 1952 C. WEEKS 2,613,313

ULTRAVIOLET FLASHLIGHT AND ENERGIZING UNIT THEREFOR

Filed Dec. 9, 1950 2 SHEETS—SHEET 1

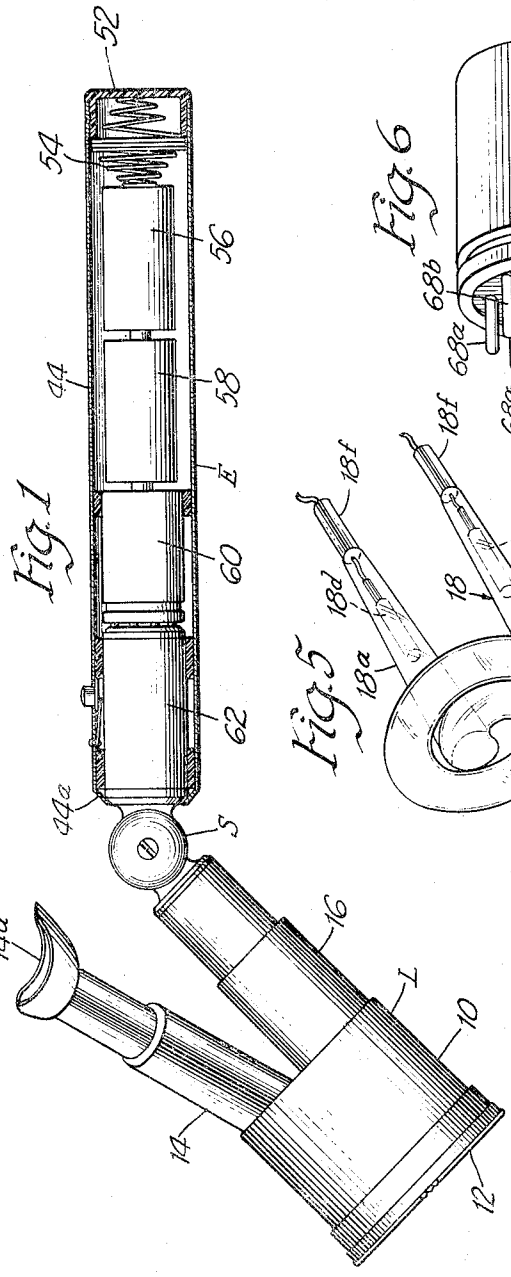


Fig. 1

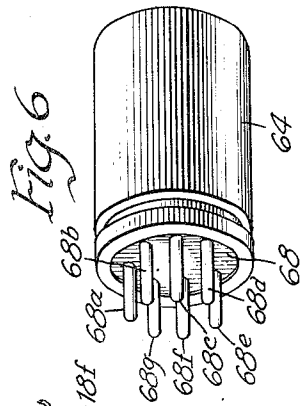


Fig. 6

Fig. 5

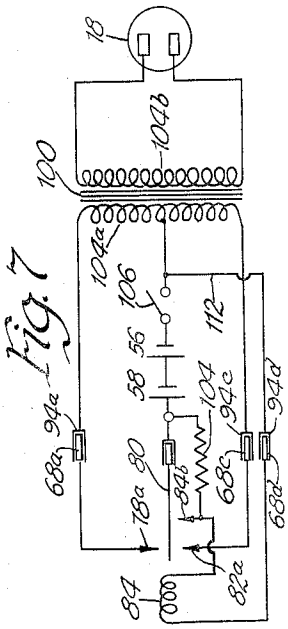


Fig. 7

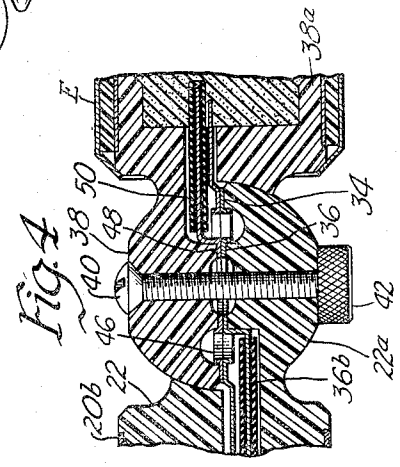


Fig. 4

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ULTRAVIOLET FLASHLIGHT AND ENERGIZING UNIT THEREFOR

Filed Dec. 9, 1950 2 SHEETS—SHEET 2

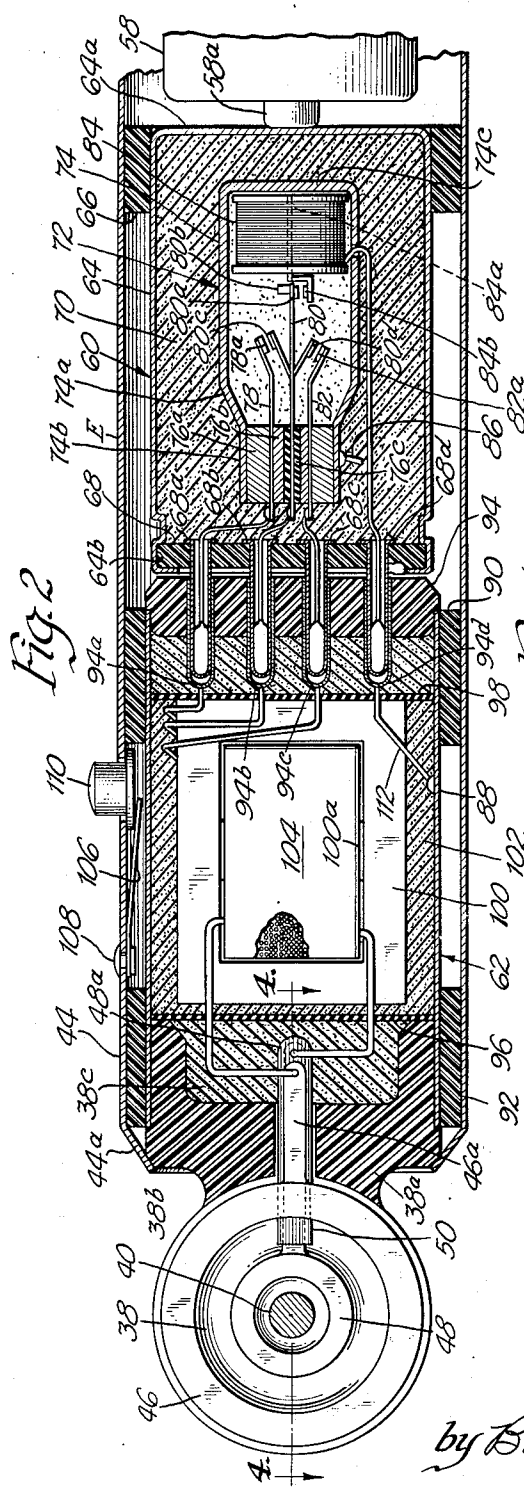


Fig. 2

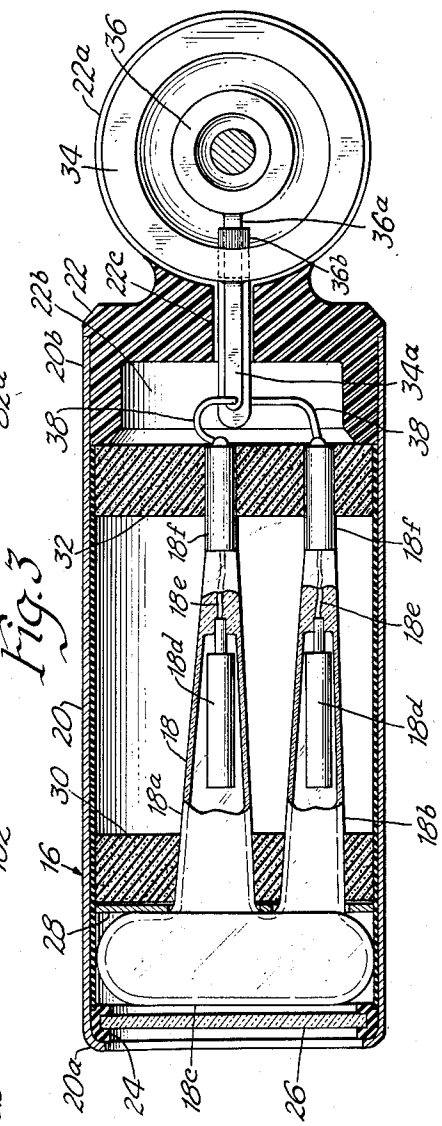


Fig. 3

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UNITED STATES PATENT OFFICE

2,613,313

ULTRAVIOLET FLASHLIGHT AND ENERGIZING UNIT THEREFOR

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Application December 9, 1950, Serial No. 200,010

6 Claims. (Cl. 240—10.6)

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My invention relates to an improved ultra-violet flashlight and energizing unit therefor, characterized by simplicity and inexpensiveness of construction, reliable and efficient operation, small size and light weight, and freedom from undesirable vibration.

In prospecting, examination of art works and documents for changes, and for other purposes, ultra-violet light gives data that cannot otherwise be obtained. However, the ultra-violet light sources heretofore available have required a source of power current and in addition are bulky and heavy, thus being unsuitable for use in remote or inaccessible locations where the requisite energizing power cannot conveniently be obtained.

In accordance with the present invention an ultra-violet flashlight is provided which is entirely self-energized and operates in a simple and convenient manner in many respects similar to the operation of a conventional flashlight and has the small size and light weight characteristics similar to a flashlight. Briefly, the unit of the present invention comprises an elongated conducting tube in which a transformer unit, a vibrator unit, and conventional flashlight batteries are received. A switch accessible from outside the casing or tube operates, when depressed, to establish an electrical energizing circuit from the batteries to the vibrator and hence the primary coil of the transformer. A low pressure mercury vapor lamp producing light of the characteristic mercury ultra-violet wavelengths is connected across the secondary of the transformer and is energized when the switch is actuated. The mercury vapor lamp consists of an elongated tube with a spiral light emitting portion parallel to and adjacent a visible light filter and a pair of parallel electrode carrying leg portions extending backwardly from the spiral portion. The lamp is sustained by resilient support elements received by the housing and in engagement with the leg portions of the lamp. The ultra-violet light output is concentrated in the viewing direction by a highly efficient reflector mounted in the housing for the tube.

It is therefore a general object of the present invention to provide an improved ultra-violet flashlight and an energizing unit therefor.

Another object of the present invention is to provide an improved ultra-violet flashlight of light weight and small size suitable for hand held portable use.

Another object of the present invention is to provide an improved ultra-violet flashlight unit

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wherein the light emitting area of the lamp is efficiently utilized.

A further object of the present inventoin is to provide an improved self-contained energizing unit for a mercury vapor lamp capable of efficiently energizing the lamp from self-contained flashlight type batteries.

A further object of the present invention is to provide an improved self-contained energizing unit, a mercury vapor lamp characterized by simplicity, ease of handling, ready replacement of parts, and reliability.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization, nature of operation, as well as other objects and advantages thereof, will best be understood by reference to the following description taken in conjunction with the accompanying drawing, in which:

Figure 1 is a side elevational view with parts in axial cross-section of a complete ultra-violet flashlight constructed in accordance with the principles of the present invention;

Figure 2 is an enlarged axial cross-sectional view with parts in elevation of a fragmentary portion of the energizing part of the unit of Figure 1;

Figure 3 is an enlarged axial cross-sectional view of the lamp and adjacent housing portions therefor of the unit of Figure 1;

Figure 4 is a fragmentary cross-sectional view through axis 4—4, Figure 2, showing the swivel slip ring coupling between the lamp and the energizing unit;

Figure 5 is a view in perspective of the lamp itself;

Figure 6 is a view in perspective of the vibrator unit; and,

Figure 7 is a schematic circuit diagram of the device.

Referring now to Figure 1, there is shown generally at E the battery containing energizing unit for the ultra-violet flashlight and at L the lamp unit therefor. These two units are joined by a swivel joint, indicated generally at S, which permits rotation of the lamp unit relative to the energizing unit while maintaining the necessary electrical connection therebetween.

The lamp unit consists of a dark chamber housing 10 which is of cylindrical cup-shaped conformation and has a detachable end cap 12 which seals the same and supports the sample being inspected. Alternatively, the cap 12 may be omitted and the open end of the housing 10

pressed against the object being examined. The closed top end of the housing 10 is apertured to receive the eye piece 14 having an eye-receiving cap 14a through which the interior of the housing 10 may be viewed. The lamp housing 16 also opens into the housing 10 to illuminate the contents thereof with ultra-violet light as hereafter described.

When the ultra-violet flashlight is used, the energizing unit E through the swivel connection S energizes the lamp in housing 16 to illuminate the interior of housing 10 for viewing through the eye piece 14. Preferably the eye piece 14 includes magnifying elements to aid inspection.

The mechanism contained within the lamp housing 16 is shown in detail in Figure 3 which is a cross-sectional view through the axis thereof with the lamp 18 shown in broken away elevation. The housing 16 is formed by a sleeve 20 having an inturned forward lip portion 20a defining a window and its rear portion 20b receiving the non-conducting plastic head 22. The head 22 is removably received in the end 20b of the sleeve 20 by reason of a tight frictional grip or some similar means such as, for example, a threaded or bayonet connection. Interiorly of and behind the window defined by portion 20a, the lamp housing 16 receives the rubber gasket 24 which in turn has a peripheral interior groove in which the ultra-violet filter 26 is held. The lamp 18 is supported immediately in back of filter 26 by the joint action of the reflector disk 28, the cushioning insert 30 which snugly receives the legs 18a and 18b of the lamp 18, and the cushioning insert 32 which receives the ends of legs 18a and 18b. The cushioning or shock mount inserts 30 and 32 may be of any suitable cushioning material, such as, for example, sponge rubber.

Reflector disk 28 is of circular shape to be received in the sleeve 20 and has an elongated slot to receive the legs 18a or 18b of the tube 18. Preferably this reflector is of aluminum with a reflective surface, known in the trade as an "Alzak" reflector. This material has the property of reflecting 90 per cent of the ultra-violet light and increases the useful light output of tube 18 by about 100 per cent.

The lamp 18 comprises a pair of legs 18a and 18b aligned with the axis of the housing 20 and having at their front end portions a spiral connecting tube 18c as shown in Figure 5. Each leg 18a and 18b has an electrode 18d mounted on a conductor 18e extending to the closed end of the leg as shown in Figure 3. Such conductor 18e extends from its electrode 18d through the end of the corresponding leg to terminate in a conducting cap 18f, Figures 3 and 5, which is external to the tube. The interior of the space defined by the legs 18a and 18b, together with the spiral tube 18c is evacuated and a small amount of mercury placed therein. When high alternating voltage is impressed across electrodes 18d, an arc discharge takes place between these electrodes to produce the intense ultra-violet line characteristic of mercury discharge. The major portion of the light producing area of the tube 18 comprises the convolutions directly behind the filter 26 so that efficient production of illumination at the end of tube 18 is provided. If a dark chamber housing 10 is used, this illumination, of course, is in that chamber. Filter 26 removes the visible components of illumination so that the interior of the chamber 10 is illuminated only with invisible light and fluorescence of the material in the dark chamber may be observed without interference.

The insulating cap 22 on the rear end of the light housing 16 terminates in a semi-spherical portion 22a which carries on its open face a pair of concentric circular slip rings 34 and 36. These slip rings are of copper, Phosphor bronze, ½ hard spring bronze, or like material, and have conducting end tabs 34a and 36a, respectively, which extend into the chamber 22b formed in cap 22. Adjacent shock mount 32, wires 38 are soldered to the sleeves 18f of lamp 18. The opposite ends of the wires 38 are soldered to the conducting tabs 34a and 36a, respectively, thus defining a complete conducting path which may be traced from slip ring 34 through tab 34a, one conductor 38 to lamp 18 to the other conductor 38 and tab end 36a to the inner slip ring 36. Consequently, when suitable high voltage is available across the slip rings 34 and 36, the lamp 18 is energized.

Tab 36a is insulatingly held in the slot 22c of cap 22 by the insulating sleeve 36b shown in Figure 4.

The energizing unit E has at one end a head portion 38, Figures 2 and 4, which mates with the head 22a of the lamp housing to define a complete conducting circuit through the slip rings 34 and 36 while permitting rocking motion of the lamp housing L relative to the energizing unit E. As shown in Figure 4, the head portions 38 and 22a are releasably secured together by the screw 40 having at its end a knurled nut 42 which can be tightened or loosened by hand to adjust the lamp housing L to any desired position of tilt in relation to the energizing unit E. The head portion 38, like head 22, is formed of a unitary piece of plastic, such as "Bakelite," and has a cylindrical portion 38a which is held in the metal casing 44 by the conical end wall 44a thereof which mates with a like conical or beveled edge seat portion on the member 38a. The member 38 carries on its flat face a pair of outer and inner slip rings 46 and 48, respectively. These mate with and establish a conducting connection with the slip rings 34 and 36, respectively. Each of the slip rings 46 and 48 has an elongated conducting tab 46a and 48a, respectively, which extends through the opening 38b of the head portion 38 into the end cavity 38c thereof where it receives the energizing conductors as hereafter more fully described. The tab 48a is received in the insulating sleeve 50 as shown in Figures 2 and 4.

The general construction of the energizing unit E will be evident from Figure 1. Briefly, it consists of an end cap 52 detachably secured to the end of the housing 44 opposite the conical portion 44a. This cap receives the conducting spring 54 which bears against battery 56 and establishes a circuit connection between the bottom of the battery and the conducting casing 44 as shown. This connection arises from the fact that the spring 54 is slightly out of round at its largest portion and resiliently bears against the interior of casing 44. Battery 56 seats against battery 58 which in turn seats against the conducting casing of the vibrating unit 60. This vibrating unit is received by the transformer unit 62 to which the tabs 46a and 48a, Figure 2, are connected. The vibrator interrupts unidirectional current flow from batteries 56 and 58 to cause alternating flux in the core of the transformer unit 62 to produce the high voltage requisite for the operation of the lamp 18.

The construction of the vibrator unit is shown

in detail in Figure 2 which is an axial cross-sectional view with parts in elevation. As shown, the unit consists of a conducting casing 64 of cup-shaped configuration with its bottom 64a resting against the electrode 58a of battery 58. Casing 64 is held concentrically within the tube 44 by the insulating spacer 66 which is of rubber or like material. At its open end the casing 64 defines an annular interior channel 64b in which the insulating end disk 68 is disposed. A plurality of conducting prongs or pins 68a, 68b, 68c, 68d, 68e, 68f, and 68g, Figures 2 and 6, are molded in the end disk 68 and extend beyond the confines of the housing 64 as shown. The housing 64 is filled with a resilient fill material indicated generally at 70. This material may, for example, be foam rubber.

Centrally disposed within the material 70 and in spaced relationship with the walls of the housing 64 is a vibrator unit 72, this unit being casing frame 74 made by bending over a flat steel strip in generally V-shaped conformation to form a conical neck 74a and a constricted mouth 74b. Insulating spacer sleeves 76a, 76b, and 76c are disposed within the constricted mouth 74b and support the contact elements 78, 80, and 82 which, as shown, are connected to the pins 68a, 68b, and 68c, respectively.

A winding 84 is located in the enlarged end portion of the frame 74 and encircles a centrally disposed magnetic core member 84a, this core member being received by the end 74c of the frame 74. Core member 84a is substantially concentric with tube 44. One end of winding 84 is connected to the contact element 84b mounted on the core 84a and positioned for engagement with the contact 80a mounted upon the central resilient vibrator element 80. This establishes a conducting connection from that end of coil 84 to the frame 74. This frame is connected by the wire 86 to the prong 68e, Figure 6.

The central or vibrating conductor element 80 is connected to the pin 68b as shown and is made of a suitable magnetic spring material, such as spring steel. Weight 80b is mounted on its remote end, which is in spaced relation with the tip of the core 84a to impart to the spring 80 the inertia required to create the natural frequency of oscillation required to produce the most effective frequency of current reversal for application to the transformer unit 62. In addition to the contact element 80a which engages the fixed contact 84b, the central spring-like vibrator 80 carries a pair of opposed contact elements 80c and 80d which engage the corresponding fixed contact elements 78a and 82a resiliently carried by the arms 78 and 82, which elements are respectively connected to the pins 68a and 68c.

The vibrator, in operation, defines a high speed single-pole double-throw switch operating, in one embodiment of the present invention, at about 115 cycles per second.

The tube prongs or pins 68f and 68g, Figure 6, are not used. A solder link 69 joins pin 68d and casing 60 to establish a conducting connection therebetween.

The transformer unit 62 consists of a conducting housing sleeve 88 supported concentrically with the housing 44 by the insulating spacers 90 and 92, one spacer being located on each end of the sleeve 88. At its rear end sleeve 88 receives the insulating end member 94 which carries female sockets 94a, 94b, 94c, and 94d which receive the respective prongs 68a to 68d. Other socket elements (not shown) are provided to receive the prongs 68e to 68g. At its opposite end the sleeve 88 receives the portion 38a of head 38 which extends therein up to the insulating spacer disk 96. A similar spacer disk 98 is located in spaced relation with the ends of the sockets 94a to 94d, as shown. The transformer core 100 is located within the space defined by sleeve 88 and spacers 96 and 98 and is supported therein by a resilient fill material 102 which may, for example, be foam rubber. Windings 104 are mounted on the center leg 100a of the core 100 and are connected as described in further detail hereafter.

The vibrator 60 and the transformer unit 62 are energized at will through the contact making switch defined by resilient conducting leaf 106 which is held to the conducting outer sleeve 44 by rivet 108 and at its free end bottoms against the detent 110. When the detent 110 is depressed, the conducting leaf 106 engages the side of the conducting sleeve 88 to establish a circuit connection through conductor 112 to the pin 68d and the winding 84. When this connection is established, the vibrator is actuated and power fed through the transformer unit 62 to the lamp.

The energizing circuit for lamp 18 is shown schematically in Figure 7. As shown, the batteries 56 and 58 are connected through the resilient switch leaf 106 to the center tap of the primary 104a of the transformer windings 104, this connection being made by reason of a conductor extended from the sleeve 88 to this primary center tap. The ends of primary winding 104a are connected to socket elements 94a and 94c which receive the pins 68a and 68c, respectively, to which the contact elements 78a and 82a are connected, respectively. The sleeve 88 is connected by conductor 112 to one end of winding 84, this connection being established through the socket 94d and the prong 68d. The opposite end of the winding 84 is connected to the contactor 84b.

When the unit is operating, the vibrating element 80 is maintained in a vibrating condition by reason of repetitive contacts with element 84b. Each time contact is established, current from batteries 56 and 58 flows through the winding 84 to create magnetic flux in core 84a, Figure 2, to pull the element 80 away from the contactor button 84b, thereby interrupting the circuit. When interrupted, the circuit no longer exerts force on the resilient contact member 80 and thereby releases the same to spring to the contact making position. By this action the element 80 vibrates back and forth at a frequency determined by its natural resonant frequency of vibration.

When the element 80 is in vibration, contactors 80c and 80d, Figure 2, alternately contact elements 78a and 82a. This causes current flow from batteries 56 and 58 to the respective halves of winding 104 thereby creating in the core 100 an alternating magnetomotive force and magnetic flux. This induces corresponding alternating voltage in secondary winding 104b to energize the lamp 18.

Resistance 114 is provided across the contacts 84b and 90a to minimize sparking and the incident contact pitting.

In an actual unit constructed in accordance with the principles of the present invention, the input current to the winding 104a was found to average 1.2 amperes and the voltage across the winding found to be 2.9 volts R. M. S. Voltage across the secondary 104b as read by a conven-

tional indicating meter was 250 volts and the current flow 18 milliamperes. The voltage wave across the secondary 104b, however, was highly peaked and reached momentary values of 2500 volts to 3500 volts. These peak voltages act to initiate discharge in tube 18 which is maintained by the lower voltage during the remainder of each half wave to give an effective ultraviolet radiation.

From the above description it will be apparent that the unit of the present invention acts as an ultra-violet flashlight to produce an efficient ultra-violet illumination from conventional flashlight type batteries. The device accomplishes this by the use of small light weight elements which, by reason of their disposition, do not transfer undue vibration to the hand of the operator or to the sample being tested. Moreover, the unit may be completely disassembled by merely removing the end cap of the unit and withdrawing the various portions thereof. If necessary, a replacement vibrator or transformer unit may be inserted without difficulty.

The dark chamber housing 10 is not necessary to the operation of the lamp unit L since effective direct observation of fluorescence may be made in subdued light in many instances. The dark chamber 10 is accordingly in the nature of an accessory that may or may not be provided as desired.

While I have shown and described a specific embodiment of the present invention, it will of course be understood that I do not wish to be limited thereto and that many modifications and alternative constructions may be made without departing from the true spirit and scope of the invention. I therefore intend by the appended claims to cover all such modifications and alternative constructions as fall within the true spirit and scope thereof.

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

1. A self-contained energizing unit for a mercury vapor ultra-violet light source, comprising; an elongated conducting tube; relatively massive transformer and battery units disposed in the tube; and a vibrator unit sandwiched between the transformer and battery unit, the vibrator unit comprising a housing snugly received by the tube, a resilient fill material in the housing, and a mechanical contact making vibrator mechanism disposed in the fill material.

2. A self-contained energizing unit for a mercury vapor ultra-violet light source comprising, in combination; a lengthy conducting housing tube; an insulating head fixedly disposed in the tube and having contact elements adapted to receive mercury vapor lamp connections; a transformer unit insulatingly disposed in the tube and abutting the head, the transformer unit comprising an electrically conducting sleeve having a detachable connector element at one end, and a transformer insulatingly supported in the sleeve and having its output connections connected to the said contact elements and its input connections connected to said connector element; switch means accessible from outside the tube and operable in the actuated condition to establish a circuit from the tube to said sleeve; a vibrator unit adjacent the transformer unit, the vibrator unit comprising a conducting housing insulatingly supported from the tube, a detachable connector defining a closed space in conjunction with the housing and received by the detachable connector element of the transformer, a resilient fill in said space, and a mechanical vibrator centrally disposed in said fill and connected to said last connector element; a battery in said tube adjacent the vibrator unit and electrically connected to the housing; and a cap for the end of the tube having resilient elements urging the transformer, vibrator, and battery together and establishing a connection from the battery to the tube.

3. In a self-contained unit to energize a mercury vapor ultraviolet light or the like, the improvement comprising: a lengthy conducting tube; a transformer unit within the tube, the unit comprising a conducting sleeve insulatingly mounted within the tube, a transformer within the sleeve, and longitudinally separable connector terminals at one end; a vibrator unit within the tube and adjacent said end of the transformer unit, the vibrator unit comprising a cup-shaped conducting housing, a vibrator supported in the housing, and connector terminals at the open end received by the terminals of the transformer unit; and switch elements selectively operable to establish a circuit connection between the tube and the sleeve of the transformer unit, the transformer unit and the vibrator unit having cooperating circuit connections to energize the transformer and vibrator when D.-C. voltage is impressed between the housing of the vibrator and the tube and the switch elements are closed.

4. In a self-contained unit to energize a mercury vapor ultraviolet light or the like, the improvement comprising: a lengthy conducting tube; a transformer unit within the tube, the unit comprising a conducting sleeve insulatingly mounted within the tube, a transformer within the sleeve, and longitudinally separable connector terminals at one end; a vibrator unit within the tube and adjacent said end of the transformer unit, the vibrator unit comprising a cup-shaped conducting housing, a vibrator supported in the housing, and connector terminals at the open end received by the terminals of the transformer unit; and switch elements selectively operable to establish a circuit connection between the tube and the sleeve of the transformer unit, the transformer unit having circuit connections from the transformer and the tube to the connector terminals, and the vibrator unit having cooperating circuit connections from the vibrator to the vibrator unit connector terminals and to the housing of the vibrator to energize the transformer and vibrator when D.-C. voltage is impressed between the housing of the vibrator and the tube and the switch elements are closed.

5. A self-contained unit to energize a mercury vapor ultraviolet light or the like from flashlight batteries comprising in combination; a lengthy conducting tube; a transformer unit at one end of the tube, the unit having a conducting sleeve insulatingly received in the tube, a transformer carried by the sleeve, and longitudinally separable connector terminals at one end of the sleeve and connected to the transformer and to the sleeve; a vibrator unit received in the tube adjacent the transformer unit, the vibrator unit having a cup-shaped housing insulatingly received in the tube, a vibrator in the housing, connector terminals mating with the terminals of the transformer unit, and circuit connections from the vibrator to the terminals and the housing; switch elements operable to establish a circuit connection from the tube to the sleeve, the tube and the vibrator housing being adapted to receive flashlight cells; and a closure for the end of the tube operable to establish contact between the

end cell and the tube and to compress the vibrator housing and adjacent cell into contact-making position.

6. A self-contained unit to energize a mercury vapor ultraviolet light or the like from flashlight batteries comprising in combination; a lengthy conducting tube; a transformer unit at one end of the tube, the unit having a conducting sleeve insulatingly received in the tube, a transformer carried by the sleeve, and longitudinally separable connector terminals at one end of the sleeve and connected to the transformer and to the sleeve; a vibrator unit received in the tube adjacent the transformer unit, the vibrator unit having a cup-shaped housing insulatingly received in the tube, a vibrator in the housing and floatingly supported thereby, connector terminals mating with the terminals of the transformer unit, and circuit connections from the vibrator to the terminals and the housing; switch elements operable to establish a circuit connection from the tube to the sleeve, the tube and the vibrator housing being adapted to receive flashlight cells; and a closure for the end of the tube operable to establish contact between the end cell and the tube and to compress the vibrator housing and adjacent cell into contact-making position.

CHARLES WEEKS.

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