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My present invention relates generally to a portable lamp and more particularly to a portable battery-operated lamp which employs a fluorescent tube as a light source.

A portable lamp which employs a fluorescent tube as a light source is presented with these factors: (1) the linearly extended character of the fluorescent tubes and the commercial standardization of their length; (2) the size of the dry cells required for their energization; (3) the wiring required by their electrodes to a degree where the arc begins to strike across the tube from electrode to electrode and thereafter to transmit the integration of electric energy along a shortened path which includes the arc as a component element; (4) the auxiliary equipment required because of the inherent negative resistance which characterizes all electrical discharge purposes and for other purposes to be pointed out in this specification.

An object of my invention is a portable lamp employing a fluorescent tube as the light source and self-contained batteries as the source of energy which is compact, of minimum weight and dimensioned and contoured for convenience and ease of portability.

A further object of my invention is a portable lamp of the character referred to, which is comprised of units so constructed, devised and related that the lamp can be assembled and disassembled quickly without requiring any tools or implements or any wiring skill or knowledge.

A further object of my invention is a portable lamp of the character referred to wherein the parts are held assembled against movement during manipulation of the lamp for portable illumination.

Another object of my invention is a portable lamp of the character referred to which is inexpensive to build and inexpensive to maintain and for which replacements can be readily and quickly effected.

I attain some of the objects of my invention by assembling the electric wiring and auxiliary equipment required for energizing the portable lamp from the batteries into a small compact unit.

I attain other objects of my invention by so contriving and relating the lamp encasement to the other lamp components so as to simplify the assembly operation.

I attain still other objects of my invention by so contriving the parts of which the portable

lamp is contrived that the electric circuits are established automatically by and as the parts are assembled.

Another object of my invention is the provision in the circuit or circuits of an arrangement whereby, when the battery has run down under normal operating conditions to a point where they are unable to energize the fluorescent tube, a change can be effected in the circuit so that the dropped battery voltage will nevertheless be sufficient to energize the tube for an additional period of time.

For the attainment of these objects and such other objects as may hereinafter appear or be pointed out, I have illustrated an embodiment of my invention wherein -

Fig. 1 is a perspective view of my portable lamp assembly;

Fig. 2 is a cross section taken on line 2-2 of Figure 1;

Fig. 3 is a section taken on line 3-3 of Figure 1;

Fig. 4 is an exploded view of the lamp assembly of Figures 1 and 2 showing the component parts of that assembly;

Figs. 5, 6, 7 and 8 show details;

Fig. 9 shows the circuit employed in my lamp; and

Fig. 10 shows the switch for the circuit.

Upon reference to Figure 4 of the drawing it will be observed that the portable lamp of Figure 1 is comprised of these units or parts: a casing body A; a cover or closure B for casing A; and three units to be contained therein in the relationship shortly to be described and which three units I have identified in Figure 4 as C, D and E respectively.

I will proceed to describe first each of these five elements or units in a general way so that their assembly, the completion of the circuits by and as part of such assembly and the provision made for wiring and accessories, may be understood in a general way and I will then proceed to a more complete description of the structural and functional aspects of these parts and their relations.

The member A is the casing body. It is intended to receive and contain units C and D. It is made preferably although not necessarily from sheet material by stamping and assembly operations to provide a containing space therewithin defined by side walls 10 and 11, top wall 12, bottom wall 13 and back wall 14 (see Figures 2 and 3).

The body member or container A is shown as generally rectangular in shape and dimensioned and proportbned as shown to serve my general objects as will appear as this description proceeds. Within the container and secured to the opposite side walls 10 and 11 are inwardly-directed ledges or shelves 17 and 18 shown in the drawings as formed by securing angle-shaped lengths to the inside surface of these two opposite walls. These ledges or shelves 17 and 18 which are relatively narrow are in spaced-apart horizontal registration. They define an upper compartment into which the unit D is to be received. Therefore the width, length and depth of this upper compartment is made such that unit D can be moved or slid thereinto and seated on the ledges 17 and 18 so as to be fully contained within this upper compartment portion of container A.

A second pair of shelves or ledges 19 and 20 are provided adjacent the bottom 13 of container A. They are shown as spaced slightly thereabove for reason that will be pointed out. They also are relatively narrow and in horizontal spaced-apart registration and shown as formed from angled pieces whose vertical walls rest on the casing bottom and are secured to the casing side walls 10 and 11. There is thus provided a second compartment in the container A, defined at the top by the ledges 17 and

18 and at the bottom by ledges or shelves 19 and 20. This compartment is dimensioned to receive unit C which comprises the batteries 25 and 26 connected in series as will be pointed out shortly.

Since my invention contemplates that the units C and D when positioned in their respective compartments will be held against movement, which is highly desirable and even necessary for a portable light, the fit of the units C and D into the respective compartments is purposefully made sufficiently snug to develop a slight frictional engagement between these units C and D and the casing walls 10 and 11 which is not however sufficient to prevent quick assembly and disassembly without tools.

Attention is invited to the fact that the spaced-apart relation of the two ledges 17 and 18 opens the lower compartments to the upper compartment for the major portion of its width. The purpose of this will be pointed out shortly.

Unit C comprises the two batteries 25 and 26. While these batteries may be of any standard type they must be capable when connected in series, to deliver a sufficient voltage to energize the tube. Their shape and dimensions must reflect the fact that they are to fit snugly in the lower compartment and in this aspect the dimensions of the lower compartment

and unit C can be stated as complementing each other.

When the unit C is inserted into the lower compartment it will be observed that the battery terminals 27, 27', 28 and 28' are uppermost and are accessible through the space between the ledges 17 and 18, and the significance of this will be pointed out in connection with unit D which I will now proceed to describe.

Unit D comprises the wiring and accessories required to complete the circuit from the batteries of unit C to the lighting unit E which is to be energized by these batteries and upon reference to Figure 4 it will be observed that this unit is comprised of an assembly frame within which the parts are secured and that this assembly frame comprises a front plate 30 and upper and lower straps 31 and 32, each bent rectangularly as shown and secured to the front plate through their inwardlybent flanges 34 to the front plate 30 in any preferred or desired manner as by means of screws 36. All the wiring and electrical parts, with the exception of the batteries and the fluorescent lamp, are contained within this frame or structure which is comprised of its front plate 30 and the straps 31 and 32, and further reference will be made to these electrical parts

when the circuit of Figure 9 is discussed except that it will be pointed out that depending from the unit D and forming part thereof are the two lead wires 40 and 41 having their ends received through a sheet of insulating material 44 and projecting therebeyond as shown to provide the two terminals 45 and 46 which project below the assembly member 44. For further details of this portion of the unit reference will be made to Figure 3 of the drawing wherein are shown two additional contact members 47 and 48 which also project outwardly below the lower surface of the assembly member 44 and which terminals in turn are connected together by the conductor 49 which may be a flat strip of material such as copper.

From the description thus far given it will be observed that before both units C and D are fully nested within the container A as aforementioned, the four contacts 45, 46, 47 and 48 projecting downwardly below member 44 can be received in the battery terminals 27, 27', 28 and 28' so as to connect the two batteries in series and complete the circuit through units C and D. In this way the two units as they are brought into assembled relation in body member A are placed in electrical contact to complete that portion of the circuit in a simple manner. The member 44 is relatively stiff and serves as a

handle whereby the contacts can be manually connected up as stated.

Attention is now invited again to the face plate 30 of unit D from the front face of which project the four contacts 50, 51, 52 and 53 each slidable within the face plate but spring pressed to their outward position by springs 55 (see Figure 7). It will be here stated that each of these contacts is wired up to the circuit wiring contained within the unit D in a manner shortly to be described by reference to Figure 9.

Unit E is the illuminating unit. It is comprised of the base member 60, the reflector 61 carried by the base and the fluorescent tube 62 detachably mounted in front of the reflector. Before describing the character of these respective three elements and the manner of their association I will point out (a) that the overall dimensions of Unit E are such that this unit can be nested within unit B about in the relation therein shown in Figure 2; (b) that the electrodes of the fluorescent tubes are wired to the contacts 65, 66, 67 and 68 which project backwardly to the rear from the base element 60 (see Figure 6) and are so located that they can all be brought simultaneously into registration respedtively with the four contacts 50, 51, 52 and 53 of unit D in the manner and by a construction such as shown on an enlarged scale in Figure

7 with reference to two of these contacts; and (c) that when the cover member B with unit E nested therein as aforementioned, is brought into its body-closing relation to the container body A with unit D positioned therein as aforementioned, contacts 65, 66, 67 and 68 will be automatically engaged with the corresponding group of contacts on unit D, which position of the parts is shown in Figure 2, thus automatically to complete the circuits from the respective electrodes through the wiring unit D and the battery unit C.

Unit B serves these purposes among others: it forms the closure for the body A; it nests the lighting unit E for assembly purposes; it holds the parts in physically-assembled relation as well as in electrically-assembled relation; its front face is comprised for its major area of a light transmitting medium 70 such as glass through which the light from the fluorescent tube 62 is projected outwardly.

The body member A and the cover unit B are provided with interengaging means whereby they can be locked together in their position of Figure 1 to complete the assembly. It will be pertinent to state here that the internal depth of the cover member B is such that when unit E is nested therewithin

the four walls of the former extend beyond the latter and the portion of the cover member B defined by these extending wall portions 71 is widened as shown to leave a shoulder and against which the outer edges of the walls of the body member A engage as shown in Figure 2. As a result the inner surfaces of the corresponding walls of the members A and B register. These structural features determine the engagement of contacts 68, 67, 66 and 65 with the contacts 50, 51, 52 and 53 respectively.

At this point the assembly procedure of the units will be briefly reviewed: (1) the four contacts 45, 46, 47 and 48 are manipulated into engagement with the four battery terminals 27, 27', 28 and 28' and the units C and D positioned in casing A. In this manipulation the platform 44 of unit D is helpful as the contacts 45, 46, 47 and 48 are rigidly secured thereto, as is also the fact that the wiring 40 and 41 is of excess length so as to permit the platform 44 to be shifted freely to effect the engagement; (2) the illuminating unit E is nested freely within cover member B; (3) the cover member B and the body member A are brought into their overlapping engagement of Figure 2 to complete the encasement, the assembly of the units and the electrical assembly.

The base member 60 may be made of any non-conducting material such as wood and is shown cut away intermediate its opposite longitudinal edges (see 72 in Figs. 3 and 4) to provide a hand grip for placing and removing unit E into or out of cover member B.

Reflector 61 is longitudinally extended to correspond with the longitudinally-extended character of the light source. It may be made of any reflecting material. It is shown as made of a sheet material such as aluminum bent to a curvature so that its reflecting surface 73 (see Figure 3) will give the desired light distribution. The reflector is provided with the longitudinally-extended central ride 74 whose ridge line is in longitudinal registration with and in opposition to the central longitudinal axis of the fluorescent lamp 62.

The reflector has its side portions 76 bent into registration as shown in Figure 3 and the dimensions of the parts are such that these end flanges 76 can be received between the opposite wall portions 77 of the reduced extreme front end of the cover member B.

Reflector 61 may be secured to the base member 60 in any preferred or desired manner as for example by securing means shown at 78 in Fig. 2.

It will be observed that the member 60 is shown as somewhat wider than reflector 61 because it nests within a wider portion of the cover member B.

Received within the reduced front portion of the cover member B is the light transmitting, diffusing or refracting closure member 70 which may be made of any preferred or desired material such as glass or composition. This member abuts against the peripheral front rim 79 of cover member B.

The fluorescent lamp 62 is supported by and between socket members mounted centrally of the top and bottom of the base member 60. These socket members are made of insulating material and are comprised of front portion 80 within which are contained the contacts for the two base pins at each end of the lamp and rear or back portion 81 in depressions of which are received metal plates 83 electrically connected respectively to these contadts. It will suffice to point out that the lamp is engaged in position as shown in Figure 4 by registering its base pins at both ends with the slots 80' in the socket portion 80, entering the sets of pins into the respective sockets through said slots and then rotating the lamp to bring the two pins at each end into engagement with the spring pressed contacts

contained in one or the other of the lamp sockets portions 80. The lead wires 84 and 85 (see Fig. 6) connect the two plates 83 in one of the lamp sockets to contacts 66 and 67 and lead wires 86 and 87 connect the two corresponding plates in the other lamp sockets to the contacts 65 and 66 to thus complete these circuit elements which are comprised in the lighting unit E. The wiring connections are shown as effected through screws.

I will now describe the electrical circuits employed by reference to Figure 9 where C represents the batteries connected in series and 62 represents the fluorescent lamp energized thereby. However, before so doing I will premise that (a) S represents a switch of the push button or plunger type (see Figures 4 and 10) and that the lowered position of the push button will pass the current from the battery in one direction through a four-way switch shown at T in Figure 9 and the upper position of the button will pass it along another path; (b) that the lowered position of the push button provides a complete and independent circuit from the batteries to each of the lamp electrodes whereas the upper position of the push button provides a single circuit in which the two electrodes and the arc thereacross form component parts; (c) the circuit comprises an

inductor U which acts as a ballast to limit the voltage increase of the energy supplied to the lamp and (d) the circuit also includes two resistors R and R', one of which is 280 ohms and the other 130 ohms and which can be selectively thrown into the circuit by means of switch 90 shown diagrammatically in Figure 9 and graphically in Figure 4 and which can be thrown manually from its neutral position of Figures 4 and 5 in either direction to engage contacts CB or CC to complete the circuit through one or the other of the two resistors.

With the parts assembled as shown in Figures 1, 2 and 3 the location of the button or plunger switch S will underly the flexible strip 91 (See Figure 10) which closes an opening in the casing adjacent a corner of the upper end wall of the body member A as clearly shown in Figures 2 and 4. The strip 91 is of a limp material of little weight and cut oversize so that it will not impose or apply any substantial weight or pressure to the plunger S. The plunger S is normally maintained in an elevated position shown in Figure 10 by means such as a spring 92.

The first operation in energizing the lamp is to depress the plunger S by finger pressure and to maintain the plunger S depressed until the

electrodes of the lamp 62 are heated sufficiently to cause the spark to jump the gap between the electrodes. During this period when the switch is held depressed the circuit is as follows: from the batteries C through lead 100, through four-way switch T, through lead 101, through inductor U, then through the lead 102 and through the resistor R (for the starting operation it is highly desirable that the switch 90 pass the current through this resistor and for this reason should be moved to engage contact CB (see Fig. 5), then through the lead 103 to the electrode 104, then through the lead 105, then through the other path through switch T, then through lead 106, through other electrode 107, through lead 108 and back to battery C. We will term this circuit the starting circuit and as stated it will be maintained until the electrodes have been sufficiently heated, which is indexed by the fact that the lamp begins to fluoresce.

As soon as the lamp is energized, the button is released so that it resumes its upper position of Figure 10 and the circuit then is as follows: from the battery C through lead 100 to switch T, lead 101, inductor U, lead 102, switch 90, resistor R, lead 103, electrode 104, electrode 107, lead 108, back to the battery. This circuit will be called the

operating circuit because the lamp is energized thereby for normal operation.

The life of a lamp of this character, without a change of batteries, is of course dependent upon the voltage in the batteries which drops continuously until it is insufficient to energize the lamp, and actual tests with my lamp have indicated that it will continue to operate for about ten hours when the battery voltage will be insufficient to energize the lamp any longer. When this occurs, that is, when the lamp ceases illuminating, the switch 90 is manually thrown from contact CB to contact CC, see Fig. 5. This will change the operating circuit so that the resistor R will be thrown out of the circuit and the resistor R' will be thrown into the circuit in its place. As a result of the lower ohmage of the resistor R', the then reduced battery voltage will prove sufficient to again energize the lamp for an extended period of as much as four hours.

Reference has been made to the fact that the proper engagement of the cover unit B with the body unit A automatically completes the circuit. I will now point out an arrangement for assuring and maintaining that proper engagement. The bottom of the body unit A is provided adjacent its open or front edge with spaced openings 110, see Fig. 4, one of which is shown on an enlarged scale in Figure 8. The bottom of the enlarged portion

71 of the cover unit B is provided with upwardly projected members shown as pins or rivets 111 arranged so that the pins 111 can be registered simultaneously with the openings 110 and, upon viewing Figure 8, it will be observed that the openings 110 are considerably larger than pins 111 so as to permit the pins to angle freely in the openings. As a result, the initial engagement of the pins 111 in the openings 110 can be effected with the units A and B at an angle to each other as shown in Figure 8, and then the upper part of the unit A swung inwardly until the enlarged outer portion 71 thereof is fully engaged about the outer open end of the unit A as shown in Figure 2. This assures the proper engagement of units A and B, which is necessary for the reason pointed out.

The cover unit A and the body member B are provided at their top walls, with cooperating elements which lock the two units in their aforementioned relation. This can be effected in any preferred or desired way. In Figs. 2 and 4 of the drawings it is shown as comprising portion 115 projecting upwardly from the top wall of unit A having one end undercut or indented as shown at 116 and a tongue 117 which projedts from the other end and beyond the cover member. The body member in turn

has projecting from its top wall a pocket or socket member 120 to receive the projecting tongue 117 when the parts are assembled as shown in Figure 2. Secured to the pocket or socket member 120 is a pivoted locking member 122 to which is secured the bail 123 dimensioned so that, with the locking member 122 released as shown in Figure 4, the bail 123 can be received around the projecting member 115 and engaged in depression 116, so that when the pivoted locking member 122 is moved clockwise to its position of Figure 2, the engagement between the unit A and unit B will be tightened and maintained in that position, and to this end I employ a flat double acting spring 125 which cooperates with a flattened area of the hinge pin of the locking member 122 so that the locking member normally moves either to its released position of Figure 4 or to its locking position of Figures 1, 2 and 4, depending upon the angular throw of the locking lever 122 in one direction or the other.

A brief reference will now be made to the unit D which contains all the wiring and accessory parts with the exception of those already described as forming part and as assembled with the lighting unit E. These parts include resistors R and R', inductor U, push button switch S, manual switch 90,

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all assembled along with the wiring required by the circuit diagram of Figure 9 in a small compact readily placeable and replaceable unit assembly. It comprises also the front panel 30 and the spring pressed contacts. This panel may be made of material such as Bakelite. The electrical circuits can be controlled from the exterior of the casing through the operation either of the push button S in the manner already set forth or the manual switch 90 because this front panel is exposed when the cover member unit B is removed.

A brief reference will be made to Figure 7 which shows the structural character of the contacts and the manner of their engagement. The front panel of the unit D is shown at 30, the base plate of the unit E is shown at 60, one of the four rearwardly projecting contacts are shown at 68, and the cooperating contact which projects from the front panel 30 of the unit D is shown at 50. It will be observed that the contact 50 is mounted upon a slidable sleeve 130 and that the spring 55 is engaged between its widened front flange 130' and the face plate 30 so that this contact is always projected to its outermost position as limited by the outwardly projecting inner flange 131 which engages the opposite face of the face plate 30 of the unit D. As a result upon a proper engagement of the cover member

and the body member in the manner already set forth, the contact 68 will register with and engage the contact 50 in a manner to provide for manufacturing variations. It is contemplated that the arrangement is such that the engagement will be effected in a manner to slightly compress the springs. It will be understood, of course, that what I have stated of the construction and cooperation of the contacts 68 and 50 applies equally well to the engagement of contacts 65, 66 and 67 with contacts 53, 52 and 51 respectively.

The shield 70 forming the front face of the cover unit B may be made of a material such as unbreakable louvre plastic. This material consists of alternately spaced water-white transparent cellulose acetate .040" wide and black or white louvres .003" wide. Louvres run across the short dimensions. The black louvre material cuts off all light 45 degrees above the horizontal when unit is placed in a vertical position. The white louvre material functions in a manner similar to the black with the exception that when viewed from angles exceeding 45 degrees from the horizontal, the shield has a light-diffusing appearance. The louvres in either case do not interfere with light emitted at right angles to the plane of the lamp. The shield may be firmly cemented to the case front with a resilient

gasket impregnated with water-proof cement.

The light source may be a standard 6-watt T-5 fluorescent tube designed to operate at 45 volts and having an average life of 750 hours. Length overall including lamp holders 9". The lamp holders are rigidly constructed and fabricated of plastic and are designed to retain lamps under unusual vibration or shock conditions.

The batteries 25 and 26 which serve as a power source and comprise unit C, consist in the device illustrated in the drawings of 60 - 1 1/2 volt cells in series, totalling 90 volts.

The reflector is of one piece construction, die formed and designed to intercept and redirect into useful angles a large percentage of the light ordinarily lost by absorption. It may be constructed of light gauge steel treated with a suitable non-ferrous material and finished in Cladite Armor. It has parabolic cross section and has semi-specular light control properties.

The resistor R is a 10-watt, 280 ohm resistor and is wired in series with the power source which limits the current flowing through the lamp to approximately 155 milliamperes. The resistor R' is of less capacity (10 watt, 130 ohms).

It will be observed that the portable lamp is boxlike in shape and that its dimensions are of a minimum; that the parts are all accessible and readily replaceable; that the full length of the fluorescent lamp is availed of for illumination purposes and that the light will be projected in the form of a beam which is both long and wide and unusual for portable lamps of this character. It will further be observed that I have simplified the wiring arrangement in the manners set forth so that the lamp will be convenient to handle, and to this end I show the strap 140 secured at one end to the bracket 141 mounted upon the top wall of the cover member and secured on the other end to the bracket 142 extending outwardly from the rear wall 14 of the body member, as clearly shown in Figure 2.