Oct. 11, 1960 F. FRUENGEL 2,956,273

COMBINED ELECTRIC LAMP FOR ILLUMINATION AND SIGNALING

Filed April 6, 1955

FIG 1

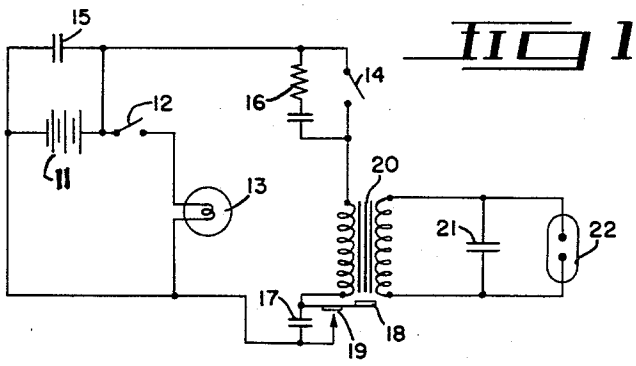
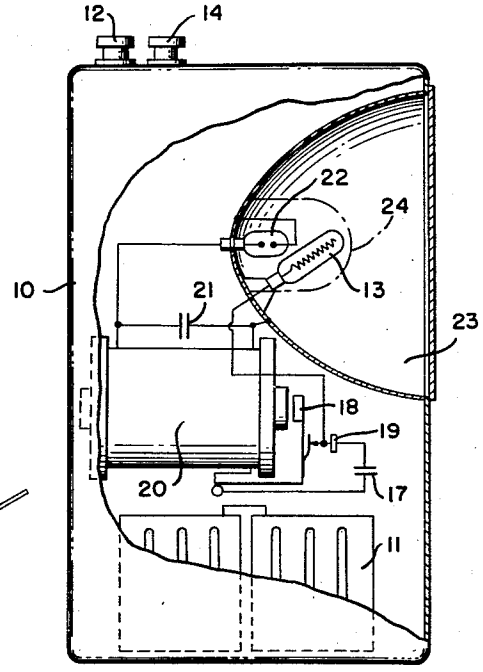


FIG 2



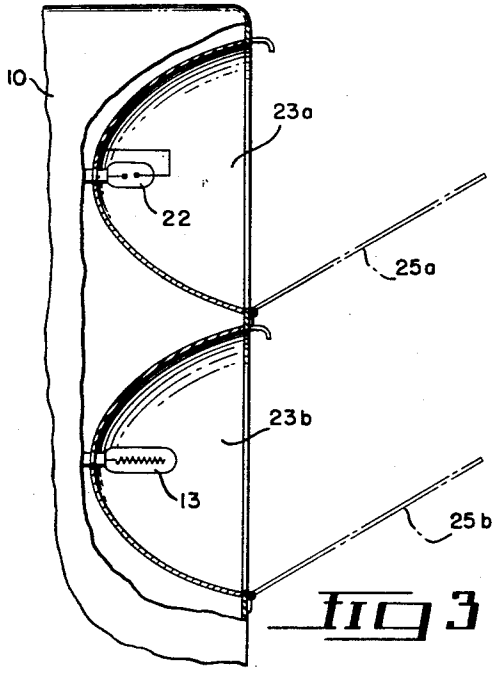


FIG 3

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COMBINED ELECTRIC LAMP FOR ILLUMINATION AND SIGNALING

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10 Claims. (Cl. 340—366)

This invention relates to an electric lamp with a storage battery as energy source, which can be used either to render illumination or to give optical signals, and its principal object is to provide such a lamp which can be used for signaling also in plain day- and sunlight and over long distances. Conventional lamps of the type referred to are usually limited in their signaling capacity to twilight or night service and are mostly provided with different color filters for codifying the signals.

In the new hand lamp as provided by this invention there is incorporated in addition to the usual incandescent light source with its switching means, a device for producing spark light in the blue-violet spectral range. For the purpose in view, the circuit of the hand lamp has in parallel connection to the incandescent light bulb a branch circuit including an interrupter having a primary and a high voltage secondary coil. The high voltage induced in the secondary coil charges a condenser which in turn discharges through a spark gap in order to produce light flashes. The interrupter is preferably in the form of a self-interrupter whose frequency is still within the audible sound range. According to this invention it is advisable to provide separate switching means for the incandescent lamp and for the spark light, which, in accordance with the desired mode of operation, can be used to switch on either continuous illumination or to serve as a Morse key for signaling. For signaling by hand with spark light, means are provided to disconnect the interrupter, as its action is not required for this operation. Incandescent light bulb and spark gap are preferably arranged in a common reflector and that as near as possible to the optical axis of such reflector, or it may be advantageous to combine filament and the electrodes of the spark gap in a common glass envelope. However, for maximum efficiency of each kind of light emission it is advisable to provide separate reflectors, one for the incandescent lamp and the other for spark light radiation; whereby the incandescent lamp reflector can be copper- or gold-plated for best reflection within the infrared spectral range, whereas the spark light reflector is preferably aluminum-plated for best reflection within the ultraviolet spectral range. Moreover, this invention provides that an infrared filter can be arranged in front of the incandescent lamp and an ultraviolet filter in front of the spark gap. In order to prevent overload on the battery the interrupter arrangement, according to this invention, is so dimensioned that the root-mean-square value of continual current impulses for spark light equals the nominal current consumption of the incandescent lamp.

For a better understanding of the useful and new features of the present invention, a preferred embodiment, as illustrated in the accompanying drawing, will now be described in greater detail.

In the drawing:

Fig. 1 is a wiring diagram of this preferred embodiment of the invention;

Fig. 2 is an elevational view of the hand lamp with parts thereof broken away and shown in section; and

Fig. 3 is a fragmental sectional detail of a modification of the lamp showing two separate reflectors and hinged light filters in front of the light sources.

Referring to the drawing, there can be seen accommodated in a suitable housing **10** a dry-cell or storage battery **11**, a switch **12** for the incandescent lamp and the incandescent lamp **13**. The connections of these elements can best be seen in the wiring diagram, Fig. 1. In addition to these basic elements there is arranged a second switch **14** and an electrolytic condenser **15** in a connection bridging battery **11**, thus representing a bypass for alternating current which could not flow through the battery on account of high resistance in the direction opposing battery polarity. A spark-suppression member **16** in the form of a resistance-capacitance combination is connected across the contacts of switch **14**.

The circuit includes furthermore a self-interrupter **18, 19** whose contacts are protected by a spark-consuming capacitance **17**. The secondary high voltage coil of transformer **20** is connected to storage condenser **21** to which in turn spark gap **22** is parallel connected. It is to be understood that spark gap **22** is not a discharge tube in the general sense of the term but is strictly a spark gap formed by two electrodes preferably accommodated in a sealed enclosure containing a filling of precious gas at a pressure somewhat above atmospheric pressure. This spark gap is designed for a breakdown voltage somewhat lower than the peak voltage of the secondary of transformer **20** by which storage condenser **21** is charged so that at reaching the breakdown voltage, a discharge of the condenser in the form of a pure electric spark is initiated. Thus, the term spark gap, or spark gap means, as used throughout this specification and the claims does not refer to discharge tubes, but to a spark gap as specified above. Condenser **21** in the present case is, as already stated, a storage condenser in which the total energy converted in each single spark is temporarily stored and is not an element for providing capacitance in an oscillating circuit as may appear at first sight. By proper selection of the parameters of the secondary circuit of transformer **20** it is possible to shift the maximum of light emission within certain limits to a preferred spectral range, for instance, to locate it in the blue-violet spectral range. For example, by selecting a condenser **21** of greater capacitance, the spark becomes hotter, because more energy is converted therein, and this higher temperature in turn shifts the light radiation emanating from the spark toward the blue spectral range, whereas with a condenser of lower capacitance, less energy is converted, the spark becomes cooler and has its maximum radiation at a point more toward the red end of the spectrum. Assuming, for instance, a spark volume of about 100 $mm.^3$ (5 mm. in diameter and 5 mm. long) and a condenser charge of $\frac{1}{10}$ joule, the spark temperature has been found to be 20,000° Kelvin, which is rather high, giving rise to intensive radiation of blue-violet light. Similar changes in the wave length of light radiation by the spark can, of course, be obtained by varying the charging voltage and/or the design of the spark gap means for a different breakdown voltage. If thus properly choosing the circuit constants, the light of the spark source **22** is clearly distinguishable by its color from the light of lamp **13**. A chief advantage of such color choice lies in the fact that the luminous efficiency of the spark gap **22** is then higher than that of the incandescent lamp **13**. The difference in color between the light from the incandescent lamp and the spark source makes it possible to operate without color filters and thus to prevent the light losses incurred by filter absorption and to utilize the small current of battery **11** to best advantage by using the normal yellow-white incandescent light for illumination and the blue-violet spark light for signaling.

However, it will be understood that also other methods of application may become useful. The switches **12** and **14** are preferably designed to serve simultaneously as on and off switches and also as signaling keys.

In order to be able to employ the present hand lamp also for telegraph messages, it is advisable to select the inherent frequency of the self-interrupter **18, 19** in a frequency band which lies within the audible sound range. The intervals between subsequent interruptions are then long enough for feeding sufficient energy to the energizing coil of transformer **20** to assure spark-overs of substantial intensity in the condenser discharge circuit **21, 22**, whenever the charge of condenser **21** exceeds the breakdown voltage of the spark gap **22**.

As shown in Fig. 2 the spark light source **22** and the incandescent lamp **13** are arranged in a common reflector **23**. The arrangement is preferably such that both light sources lie on a common axis substantially coinciding with the optical axis of reflector **23**. It is also possible to enclose filament of lamp **13** and spark gap **22** in a common glass envelope as indicated by dotted lines at **24**.

In the modification of Fig. 3 the spark gap **22** and the incandescent lamp **13** are arranged each in separate reflectors **23***a* and **23***b* respectively. Such arrangement allows for providing the reflectors with surface coatings most suitable for reflecting the particular kind of light of the appertaining source. Thus reflector **23***a* is preferably aluminum-plated for best reflection in the ultraviolet spectral range, whereas reflector **23***b* is preferably copper- or gold-plated for best reflection in the infrared spectral range. For further distinction in light color, additional means can be provided in the form of light filters, whereby an ultraviolet filter **25***a* in front of the spark gap and an infrared filter **25***b* in front of the incandescent lamp will be most suitable. It is advisable to secure the filters in place so they are readily removable when filtering of the light is not desired. Any convenient means will serve this purpose and a hinged construction is indicated in Fig. 3.

The housing of the present hand lamp is preferably provided with a visor assembly which permits to adjust the direction of far-reaching signals. The more concentrated the focusing by means of the reflector, the longer the communicating range, but the more accurate must be visor and directional setting. Particularly advantageous is the hand lamp as provided by this invention when employed in the fields of sports activities and traffic control, because its signals do not interfere with communication carried on by radio through licensed frequency channels.

The constructional details of the lamp as described herein are preferred examples only and it is to be understood that other modifications will occur to those skilled in the art which rightfully fall within the scope of the appended claims.

That what is claimed is:

1. An electric lamp for illuminating and signaling comprising a housing, an electric battery contained in the housing and serving as power source, an incandescent lamp connected in one branch circuit fed by said battery, switching means interposed in said first branch circuit, a self-interrupter, a high tension transformer, and switching means connected in series with the primary of said transformer in a second branch circuit fed by said battery, a storage condenser, said high tension transformer having its secondary connected to said storage condenser, spark gap means including a pair of electrodes in relatively closely spaced relation to form a spark gap and being connected in parallel with said condenser, said spark gap means becoming operative in producing a spark when the condenser voltage surpasses the breakdown voltage thereof, a reflector mounted in said housing, the filament of said incandescent lamp and said spark gap being arranged to substantially coincide with the optical axis of said reflector.

2. An electric lamp as claimed in claim 1, wherein the filament of said incandescent lamp and said spark gap are contained in a common sealed envelope.

3. An electric lamp for signaling and illuminating, comprising, in combination, a housing provided with two reflectors, an electric spark light source arranged in one of said reflectors and an incandescent light source in the other one of said reflectors, the reflector of said spark light source having at least the portion thereof which comprises the reflecting surface made of a material having high reflecting properties for ultra-violet radiation, and the reflector of said incandescent light source having at least the portion thereof which comprises a reflecting surface made of a material having high reflecting properties for infra-red radiation, supply means for supplying direct current circuit means and switching means accommodated in said housing, said circuit means being operative in converting direct current from said source into voltage pulses and supplying breakdown voltage pulses to said spark light source and being operative in supplying continuous voltage to said incandescent light source, said switching means being operable to change from spark light to incandescent light operation.

4. In an electric lamp for illuminating and signaling, in combination, an incandescent light source, supply means for supplying direct current to said incandescent light source, means for signaling by pure spark light flashes and including a high tension transformer, circuit connections between said supply means and the primary of said transformer, self-interrupter means and an on-off switch interposed in said connections, a storage condenser and spark gap means connected in parallel to the high-tension secondary of said transformer, said self-interrupter means being operative when said switch is in its on position to pass current impulses through said primary for inducing high-tension voltage impulses in said secondary, said spark gap means comprising a sealed enclosure and a pair of electrodes therein, said electrodes being spaced for a breakdown voltage somewhat lower than the peak value of said high-tension voltage impulses, the frequency of said self-interrupter means lying within the audible range to assure by sufficient duration of each voltage impulse complete charge of said storage condenser before breakdown of said spark gap means occurs, whereby each breakdown of said spark gap causes by instant discharge of said condenser therethrough a pure spark discharge therein rendering flashes of light within the blue-violet spectral range clearly distinguishable from the yellow-white light of the incandescent light source.

5. An electric lamp as specified in claim 4 wherein the frequency of said self-interrupter means is capable of passing current pulses substantially at a rate resulting in a root-mean-square value of current consumption during continuous spark light signaling which is substantially equal to the value of current consumption of said incandescent light source.

6. An electric lamp for illuminating and signaling, comprising, in combination, a housing provided with two reflectors, an electric spark light source arranged in one of said reflectors and an incandescent light source in the other one of said reflectors, said one reflector of said spark light source having at least the portion thereof which comprises its reflecting surface made of aluminum for optimum reflectivity for ultra-violet radiation, and said other reflector of said incandescent light source having at least the portion thereof which comprises its reflecting surface made of copper for optimum reflectivity for infra-red radiation, supply means for supplying direct current, circuit means and switching means accommodated in said housing, said circuit means being operative in converting direct current from said source into voltage pulses and supplying breakdown voltage pulses to said spark light source and being operative in supplying continuous volt-

age to said incandescent light source, said switching means being operable to change from spark light to incandescent light operation.

7. An electric lamp as claimed in claim 4, including ultra-violet filter means arranged in the path of light from said spark gap means, and infra-red filter means arranged in the path of light from said incandescent light source.

8. An electric lamp as claimed in claim 7, wherein either one of said filter means is mounted movably between a position across the path of light of the respective light source, and a position out-of-the-way of said path of light.

9. An electric signaling lamp for alternatively signaling with light signals in distinctly different spectral ranges, comprising, a housing, supply means for supplying direct current, an incandescent light source in circuit with said supply means, capacitor means in circuit with said supply means for being charged thereby, a gas-discharge spark-light source having two electrodes in circuit with said capacitor means and capable of producing brief light flashes upon application of a brief voltage impulse derived from a discharge of said capacitor means, switch means in circuit with said incandescent light source and with said capacitor means for controlling the supply of energy from said supply means to said incandescent light source and to said capacitor means, respectively, light filter means arranged in the path of light from said incandescent light source and said impulse-responsive light source, respectively, for limiting the radiation from said light sources to preselected spectral ranges, reflector means arranged in relation to said light sources for reflecting the radiation produced by said light sources, respectively, in a predetermined direction, said reflector means having at least a surface layer made of material having high reflecting properties for invisible portions of said radiation, and frequency control means in circuit with said capacitor means for predetermining the frequency of said impulses derived from alternatingly charging and discharging said capacitor means.

10. An electric signaling lamp for alternatively signaling with light signals of different character and duration, comprising, in combination, supply means for supplying direct current, an incandescent light source in circuit with said supply means, capacitor means adapted to be charged to a predetermined potential, a gas-discharge spark-light source having two electrodes in circuit with said capacitor means and capable of producing brief flashes upon application of a brief voltage impulse derived from a discharge of said capacitor means, charging means in circuit with said supply means and with said capacitor means for charging the latter, said charging means comprising a magnetizable core member, coil means wound around said core, means for varying abruptly the magnetic flux of said core for generating in said coil means voltage pulses for charging said capacitor means whenever desired.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,956,273 October 11, 1960

Frank Fruengel

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 53, strike out "the frequency of".

Signed and sealed this 11th day of April 1961.

(SEAL)
Attest:
ERNEST W. SWIDER
Attesting Officer

ARTHUR W. CROCKER
Acting Commissioner of Patents