

Oct. 15, 1935.

G. E. INMAN

2,017,719

ELECTRIC LAMP

Filed Jan. 30, 1935

2 Sheets-Sheet 1

Fig. 1.

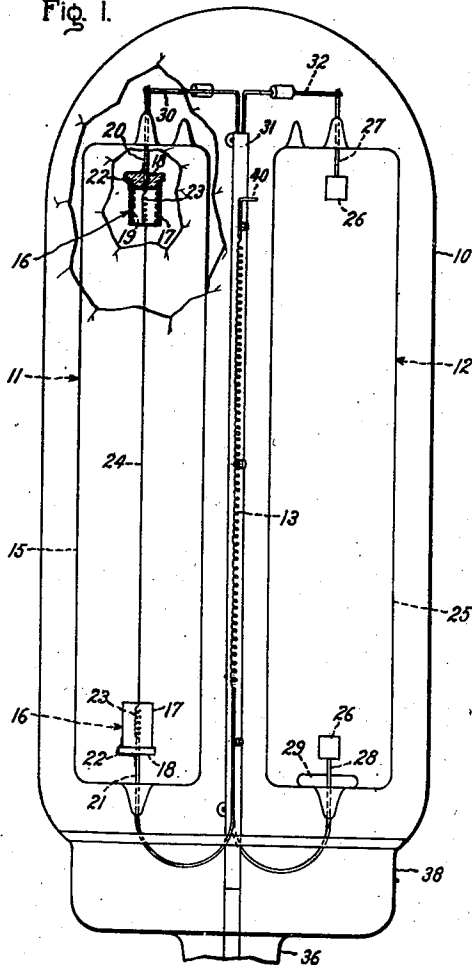


Fig. 2.

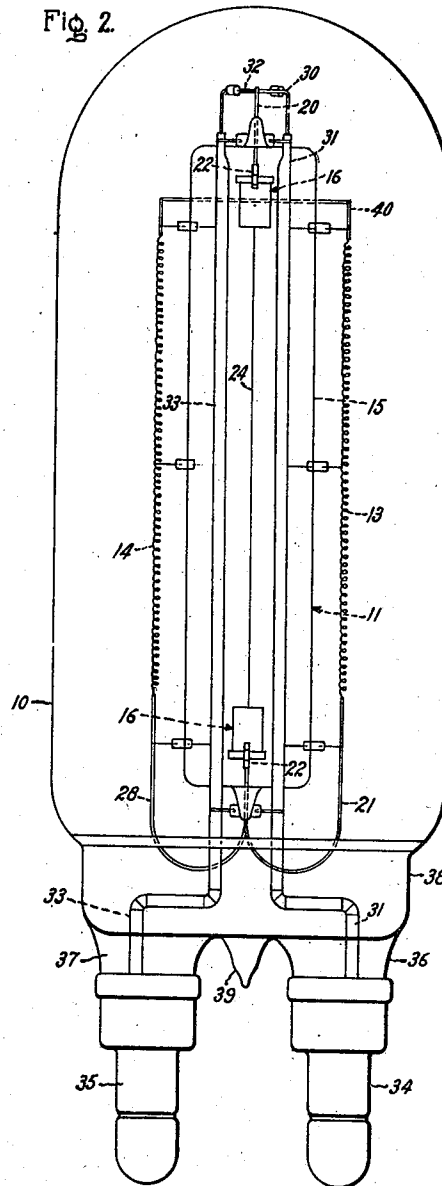
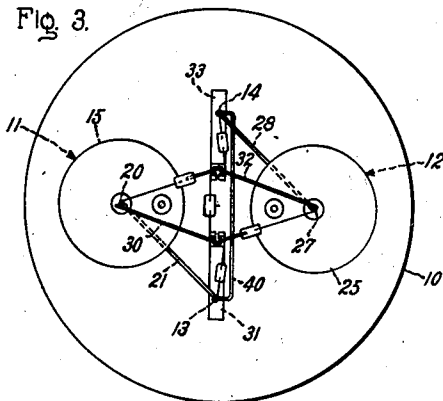


Fig. 3.



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Fig. 5.

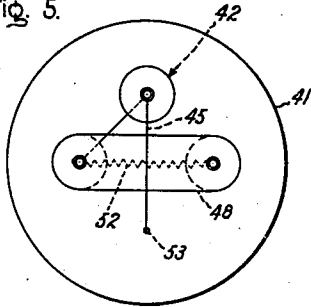


Fig. 7.

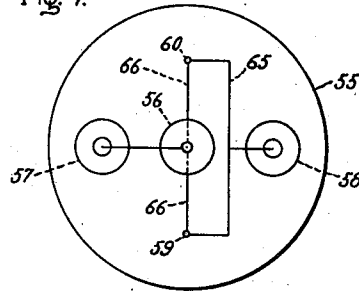


Fig. 4.

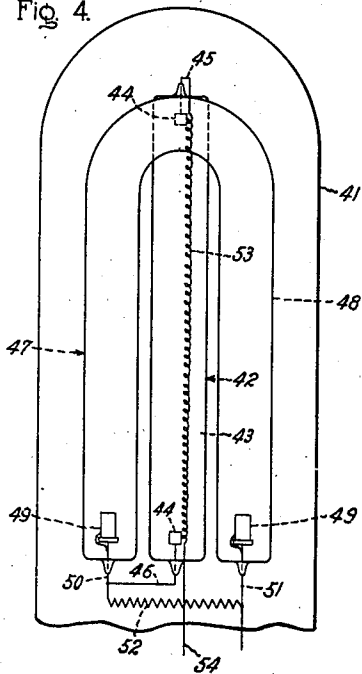
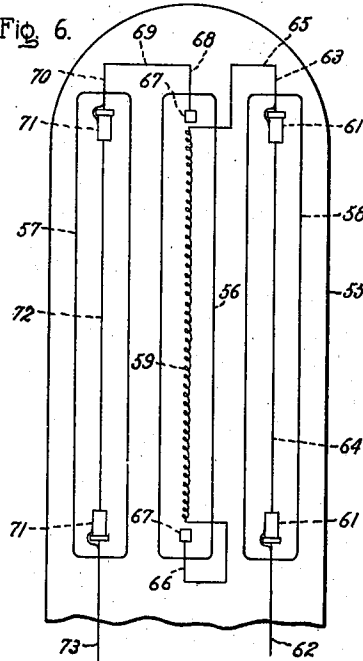


Fig. 6.



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UNITED STATES PATENT OFFICE

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ELECTRIC LAMP

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New York

Application January 30, 1935, Serial No. 4,113

4 Claims. (Cl. 176—1)

My invention relates to electric lamp units generally and more particularly to such units comprising two or more gaseous electric discharge lamp devices.

5 In lamps known in the art as high pressure metal vapor arc lamps, such as the high pressure positive column mercury lamp, the arc voltage increases after the starting of the lamp and reaches its full value after the lamp has been
10 operating an appreciable time. Such lamps have heretofore been used with a series resistance as a ballast in the form of an incandescent filament mounted externally of the container of the lamp. However, in such a circuit the voltage
15 across the filament varies inversely with the arc voltage. Consequently, when the filament is designed to be heated to incandescence during the starting period of the arc discharge, the filament is not heated sufficiently during the operating
20 period of the lamp when the arc voltage increases and it is therefore a very inefficient light source. On the other hand, if the filament is designed to be heated to incandescence during the operating period of the lamp, the filament is overloaded
25 during the starting period when the arc voltage is low which causes said filament to burn out to terminate the useful life of the lamp unit. For example, for a lamp having electron emitting electrodes and operating on a 110 volt supply line, the arc voltage during the first few minutes of operation would be about 12 and then after the lamp has warmed up, the voltage may be about 75. This means that the voltage across the filament would be about 98 for a few minutes and then gradually decrease to 35, i. e., the change in voltage is almost three to one.

One of the objects of my invention is to provide a lamp unit comprising a combination of gaseous or vapor lamps which have opposite starting voltage characteristics with a filament or filaments. Another object is to provide such a lamp in which the filament is both an efficient light source and has a long life. Another object is to provide an efficient lamp unit emitting mixed light of improved quality. Further objects and advantages of my invention will appear from the following description of species thereof.

In accordance with these objects the new lamp unit comprises two or more gaseous or vapor electric discharge lamp devices having opposite starting voltage characteristics and a filament, the lamps and filament all being connected in series. One of the discharge devices may be a high pressure metal vapor arc lamp such as a high pressure positive column mercury lamp, while another

may be a low pressure positive column lamp or the cathodic glow type of lamp, such as a sodium lamp. The voltage of a short low pressure lamp may be about 40 during the starting period and gradually decrease to about 25. The high pressure arc lamp voltage is about 12 at the start of the arc discharge and increases to about 50. On a 110 volt line this makes a voltage variation in the filament of about 58 to 35, or less than two to one. A filament designed for such a change gives some useful light during operation without burning out during the starting period. Of course, for a higher line voltage two or more low pressure lamps or one large one may be used in order to obtain a complete compensation and a very efficient lamp. The combination of sodium, mercury and incandescent filament light is also very desirable because it produces the effect of white light.

In the drawings, Fig. 1 is a front elevation of a lamp unit comprising my invention; Fig. 2 is a side elevation thereof; Fig. 3 is a plan view thereof; Fig. 4 is a somewhat diagrammatic elevation of a modified unit in which the envelope of the low pressure positive column lamp is U-shaped; Fig. 5 is a plan view thereof; Fig. 6 is a somewhat diagrammatic elevation of a further modified unit comprising two low pressure lamps; and Fig. 7 is a plan view thereof.

Referring to Figs. 1-3, the lamp unit comprises an outer enclosing envelope or bulb containing a low pressure positive column lamp 11, a high pressure positive column lamp 12, and filament sections 13, 14, preferably of tungsten or other material having a positive temperature-resistance coefficient.

The low pressure lamp 11 comprises a tubular envelope or bulb 15 having an electrode 16 at each end thereof. The particular electrodes 16 illustrated are of the internally emissive hollow type and consist of a metal tube 17 which may be of nickel, secured at its rear end to an insulating plug 18 and having a layer of electron emissive material 19, such as barium oxide, on its inner surface. The upper and lower electrodes 16 are mounted on leads 20, 21 respectively which extend through the plugs 18 to the interior of the tubes 17 and are electrically connected to said tubes by conducting strips 22. Each of the electrodes 16 also includes an internal heating resistance 23, the said resistances being connected by an axially extending conductor 24. The bulb 15 contains a difficultly vaporizable working substance such as an alkali metal vapor like sodium, and operates with very small vapor pres-

tures of such substance. The absolute vapor pressure of the working substance is usually about 1 or 2 microns for sodium. The bulb also preferably contains a small amount of easily ionized gas like neon or argon at a pressure of about 1 or 2 to 15 mm. to assist in starting the sodium or other vapor discharge.

The high pressure positive column lamp 12 comprises a tubular envelope or bulb 25 having an electrode 26 at each end thereof mounted on upper and lower leads 27 and 28. The electrodes 26 may consist of pressed and sintered refractory metal blocks or coils such as tungsten or nickel, impregnated with an electron emissive material such as barium oxide. The bulb 25 has a gaseous filling therein consisting of a readily ionizable starting gas, such as argon, and a readily vaporizable material, preferably mercury, 29.

The upper lead 20 of the low pressure lamp 11 is secured to one end of a lead 30, the other end of which is secured to the upper end of a longitudinally extending channel-shaped lead 31. The upper lead 27 of the high pressure lamp 12 is secured to one end of a lead 32, the opposite end of which is secured to the upper end of a second channel-shaped lead 33. The said channel-shaped leads 31, 33 extend downward into metal thimbles 34, 35 to which they are secured. The edges of said thimbles are sealed to tubular portions 36, 37 of a pressed glass cup 38, the rim of which is fused to the neck of the outer envelope 10. The said envelope 10 is evacuated at 39, and may be filled with a gas if desired.

An end of the lower U-shaped lead 21 of the low pressure lamp 11 is secured to the lower end of the filament section 13, while an end of the lower U-shaped lead 28 of the high pressure lamp 12 is secured to the lower end of the filament section 14. The upper ends of the filament sections 13, 14 are connected by an offset U-shaped conductor 40. The three elements: the low pressure lamp 11, the high pressure lamp 12 and filament 13, 14, are thus connected in series.

When the above-described lamp is connected to the terminals of a current source, a circuit is established from the channel lead 31, through leads 30, 20, heater 23 of upper electrode 16 of lamp 11, conductor 24, heater 23 of lower electrode 16, lead 21, filament section 13, conductor 40, filament 14, lead 28, to lower electrode 26 of the high pressure lamp 12, and from channel lead 33, through leads 32, 27 to upper electrode 26 of lamp 12. The line voltage impressed across the electrodes 26, 26 is sufficient to ionize the starting gas in bulb 25 and the arc discharge starts between said electrodes 26, 26 as soon as the gaseous atmosphere is sufficiently ionized. As soon as the arc across electrodes 26, 26 starts, the voltage across them drops to about 12, a discharge is formed between the electrodes 16, 16 of the low pressure lamp 11 and the voltage across them may be about 40. The voltage across the high pressure lamp 12 then starts to rise and the voltage across the low pressure lamp 11 starts to fall, thereby minimizing to a great extent the change in voltage across the filament 13, 14.

The modified lamp unit shown in Figs. 4 and 5 comprises an outer vacuum envelope or bulb 41 containing a high pressure positive column metal vapor lamp 42 like the lamp 12 in Figs. 1-3, preferably a mercury arc lamp, and comprising a straight tubular envelope or bulb 43 having an electrode 44 at each end, the upper electrode being mounted on a lead 45 and the lower electrode on a lead 46. The outer envelope also contains

a low pressure positive column lamp 47, preferably a sodium lamp. The tubular envelope or bulb 48 of the lamp 47 is U-shaped and has an electrode 49 at each end thereof of the "cold" type, i. e., it does not have a heating resistance adjacent thereto. The said electrodes 49 each comprise a metal tube having an electron emissive coating on the interior thereof the same as the electrodes 16 in Fig. 1. The left and right electrodes 49 are mounted on leads 50, 51 respectively which are connected by a high resistance 52. A filament 53, preferably of tungsten, is located in the outer envelope 41 and is connected to the lead 45 at its upper end and to a lead 54 at its lower end. The said filament 53 has been offset to the right in Fig. 4 for the sake of clearness.

The starting circuit of the above-described lamp unit is from lead 51 through resistance 52, leads 50, 46, to lower electrode 44 of lamp 42 and 20 from lead 54 through filament 53, lead 45 to upper electrode 44. The starting gas in lamp 42 is ionized and an arc discharge occurs between the electrodes 44 after which a discharge occurs between the electrodes 49 of lamp 47, the high resistance being cut out of the circuit. Here again, after the arc discharges start, the voltage across the lamp 42 increases and the voltage across lamp 47 decreases, thereby cutting down the voltage differential across the filament 53 at the start and 30 during operation of the lamp.

The unit shown in Figs. 6 and 7 may be used where the line voltage is higher, and comprises an outer evacuated envelope 55 containing a high pressure positive column lamp 56, like the lamp 12 in Fig. 1, two low pressure positive column lamps 57, 58 like the lamp 11 in Fig. 1, and filament sections 59, 60. The lower electrode 61 of low pressure lamp 58 is mounted on a lead 62 and the upper electrode 61 on a lead 63. The internal heating resistances (not shown) of electrodes 61, 61 are interconnected by a conductor 64. The lead 63 is connected to a cross lead 65 which is connected at each end to the upper ends of the filament sections 59, 60. The lower ends of the said filament sections are connected to a lead 66 which extends through the lower end of the bulb of lamp 56 and supports the lower electrode 67. The upper electrode 67 of lamp 56 is supported by a lead 68 which is connected by conductor 69 to the lead 70 which supports the upper electrode 71 of the lamp 57. The internal heating resistance (not shown) of said upper electrode 71 is connected to the internal heating resistance (not shown) of lower electrode 71 by a conductor 72. The said lower electrode 71 is mounted on a lead 73.

The starting circuit of the above-described lamp is from lead 62, through the heating resistance (not shown) of lower electrode 61, conductor 64, heating resistance (not shown) of upper electrode 61, lead 63, conductor 65, filament branches 59, 60, lead 66, to lower electrode 67 of the high pressure lamp 56, and from lead 73 through heating resistance (not shown) of lower electrode 71, conductor 72, heating resistance (not shown) of upper electrode 71, lead 70, conductor 69, lead 68, to upper electrode 67 of lamp 56. Here again, an arc discharge is established between the electrodes 67 of high pressure lamp 56 and then arc discharges are established between the electrodes 61, 61 of low pressure lamp 58 and electrodes 71, 71, of the other low pressure lamp 57. The rising voltage characteristic of the high pressure lamp 56 is compensated by the drooping voltage char-

acteristics of the low pressure lamps 57 and 58 to lower the voltage differential across the filament 59, 60.

It will be understood that the forms of the discharge lamps in the unit may be varied considerably from the forms illustrated, the only requirement being that gas or vapor discharge lamps having opposite starting voltage characteristics be used in order to procure a compensation of the starting and operating voltage across the series filament ballast without the use of relays, thermostats or transformers or other external equipment.

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

1. A lamp unit comprising in combination, two or more gaseous electric discharge lamps each comprising an envelope containing a pair of electrodes, one of said lamps having a rising starting voltage characteristic and another of said lamps having a drooping starting voltage characteristic, and an incandescible filament, the said filament and the gaps between the said electrodes of each of said discharge lamps being in series.

2. A lamp unit comprising in combination, a sealed outer envelope containing two or more gaseous electric discharge lamps each comprising an envelope containing a pair of electrodes, one of said lamps having a rising starting voltage char-

acteristic and another of said lamps having a drooping starting voltage characteristic, and an incandescible filament disposed in said outer envelope, the said filament and the gaps between the said electrodes of each of said discharge lamps being in series.

3. A lamp unit comprising in combination, two or more gaseous electric discharge lamps each comprising an envelope containing a pair of electrodes, one of said lamps being a high pressure lamp and having a rising starting voltage characteristic and another of said lamps being a low pressure lamp and having a drooping starting voltage characteristic, and an incandescible filament, the said filament and the gaps between the said electrodes of each of said discharge lamps being in series.

4. A lamp unit comprising in combination, two or more gaseous electric discharge lamps each comprising an envelope containing a pair of electrodes, one of said lamps being a high pressure mercury lamp and having a rising starting voltage characteristic and another of said lamps being a low pressure sodium lamp and having a drooping starting voltage characteristic, and an incandescible filament, the said filament and the gaps between the said electrodes of each of said discharge lamps being in series.

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