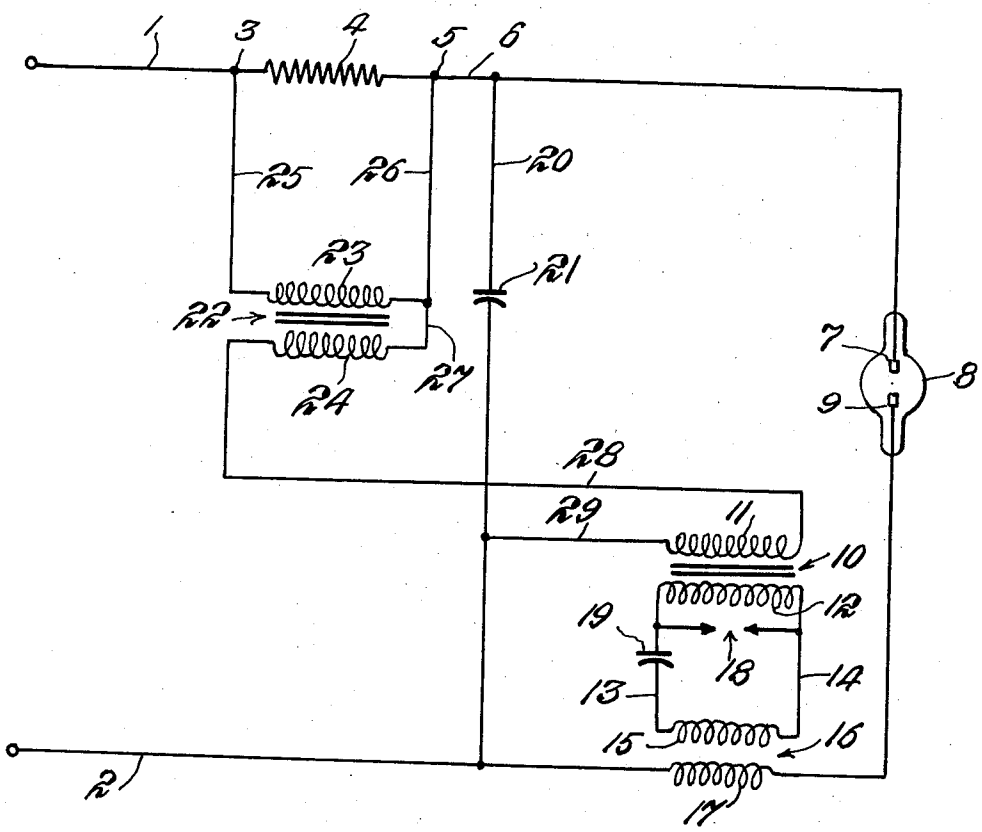
June 2, 1959 L. F. BIRD 2,889,489

STARTING AND OPERATING CIRCUIT FOR HIGH PRESSURE ARC LAMPS

Filed Oct. 15, 1957



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United States Patent Office 2,889,489
Patented June 2, 1959

2,889,489

STARTING AND OPERATING CIRCUIT FOR HIGH PRESSURE ARC LAMPS

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Application October 15, 1957, Serial No. 690,319

2 Claims. (Cl. 315—100)

The present invention relates to an operating circuit for electrical discharge lamps and more particularly to an operating circuit for the ignition and operation of high pressure gaseous discharge lamps.

While the ignition and operating circuit hereinafter described is advantageous for the ignition and operation of high pressure mercury vapor arc lamps, it is especially applicable for the ignition and operation of compact type arc lamps containing an ionizable atmosphere of a rare gas, or rare gas and a vaporizable metal, at a pressure exceeding one atmosphere.

High pressure arc lamps, e.g. compact arc lamps, are commonly connected to a source of usual line voltage, such as 120 volts line voltage, through a ballast adjusted to provide a lamp operating voltage of, for example, 75 volts. These lamps are advantageously started by means of high frequency pulses supplied from a pulse generating circuit connected across the lamp operating circuit on the lamp side of the ballast. In this location, the voltage initially supplied to the transformer energizing the pulse generating circuit is the line voltage. When the lamp is ignited, the voltage supplied to the starting transformer is automatically considerably reduced from the line supply value and becomes the lamp operating voltage, which voltage is insufficient to maintain normal operation of the pulse generating circuit and discontinues the ignition pulses.

However, problems have resulted in the automatic operation of the ignition circuit because of the difficulty in maintaining normal control of the ignition system at certain voltages which occur across the lamp. As long as the lamp voltage does not exceed about 50 volts, there is no difficulty with the ignition system. When the lamp voltages exceed 50 volts, e.g. 75 volts, it is difficult to prevent surges in voltage across the lamp from causing sporadic sparking across the spark gap of the pulse system. While this condition does not have any particular effect on the lamp, it causes radiation of radio waves from the ignition system, which can be detected by radio wave receiver means considerable distances from the location of the lamp equipment. Such condition is intolerable where absence of radio wave radiation is desirable. One remedy is to provide a manual switch means for closing the ignition circuit after lamp ignition, but this does not have the advantages of automatic operation. Another possibility is to provide a wider spacing of the spark gap to prevent the spark gap from breaking down under lamp voltages, but in such case the spark assumes a rough action and uncertain operation which does not always assure ignition of the lamp.

It is an object of this invention to provide a lamp ignition and operating system for high pressure arc lamps. It is another object of the present invention to provide a lamp operating system including an automatic high frequency pulse ignition circuit, wherein the ignition circuit voltage is automatically controlled and maintained at a value below a spark gap break-down voltage when

the lamp is burning. Other objects and advantages will become apparent from the description hereinafter following and the drawing forming a part hereof.

The drawing is a schematic illustration of the lamp operating and ignition circuit according to the invention.

The invention deals with an ignition and operating system for high pressure arc lamps including a ballast in series with a high pressure arc lamp, a pulse ignition circuit including a transformer therefor connected in the system between the ballast and lamp, and with a voltage control means for the ignition transformer particularly associated with the ballast, and whereby the transformer voltage is automatically controlled and maintained below a spark break-down of the pulse circuit.

The lamp contains spaced electrodes and an ionizable atmosphere of a rare gas, e.g. xenon, or a rare gas and a vaporizable metal, e.g. mercury, at a pressure exceeding atmospheric pressure.

Referring to the drawing, the system of the invention comprises in combination a lamp operating circuit, an automatic lamp ignition circuit, and a voltage control circuit for the ignition circuit.

The lamp operating circuit comprises supply lines **1** and **2** leading from a source of line voltage, e.g. 120 volts. One of the supply lines, e.g. line **1**, is connected to a terminal **3** of a resistance or ballast **4**. The other terminal **5** of ballast **4** is conected to a lead **6**, which is connected to an electrode **7** of lamp **8**. The other supply line, e.g. line **2**, is electrically connected to another electrode **9** of lamp **8**. The ballast **4** is in series with the lamp and has an impedance so adjusted or selected that the lamp, when burning, will operate substantially at the rated lamp wattage.

The ignition circuit comprises an ignition transformer **10**, having a primary winding **11** and secondary winding **12**. Leads **13** and **14** are connected from the terminals of the ignition transformer secondary winding **12** to the terminals of primary winding **15** of a radio frequency transformer **16**. A radio frequency transformer secondary winding **17** is spaced from its primary winding **15** and connected into supply line **2** and in series with the lamp **8**. A spark gap **18** is connected between the leads **13** and **14** and a capacitor **19** is connected into one of the leads **13** and **14**. The ignition transformer **10**, radio frequency transformer **16** and the intermediate spark gap **18** constitute components of the well known pulse type ignition circuits.

In order to isolate radio frequency from the line input circuit, a by-pass lead **20** is connected across the supply line **2** and lead **6**, with a by-pass condenser **21** connected into the by-pass lead to effect the isolation of the radio frequency.

If the primary winding **11** of ignition transformer **10** were connected directly across the supply line **2** and lead **6**, the spark gap **18** would be subject to sporadic sparking when the lamp is in operation under lamp voltages exceeding 50 volts, which effect, as aforementioned, is intolerable under certain conditions.

According to the invention, the ignition circuit is provided with a voltage control circuit comprising a transformer **22** having a primary winding **23** and secondary winding **24**, with the primary winding **23** being connected across the terminals **3** and **5** of ballast **4** by means of leads **25** and **26**. One terminal of the secondary winding **24** is electrically connected to the lead **6** by means of conductor or lead **27**. The other terminal of secondary winding **24** is connected to a terminal of the primary winding **11** of the ignition transformer **10** by lead **28**. The other terminal of primary winding **11** of the ignition transformer **10** is connected to the by-pass lead **20** through lead **29**.

It is apparent from the drawing that the ignition trans-

former 10 is electrically connected across lead 6 and supply line 2 between the ballast 4 and lamp 8 through the secondary winding 24 of the voltage control transformer 22.

When the input leads 1 and 2 are connected to the line voltage, and before the lamp is ignited, full line voltage is delivered to the ignition transformer primary winding through the secondary winding of the voltage control transformer 22. There is a negligible voltage drop across the ballast 4 and substantially no opposition to current to the ignition transformer 10 because, due to the lower resistance through ballast 4, the primary winding 23 is substantially short circuited. Therefore, the ignition transformer 10 receives substantially full line voltage and operates the pulse system which establishes an arc across electrodes 7 and 9 and ignites the lamp. This is in contrast to the subsequent action of primary winding 23 in cancelling out at least a portion of the line voltage to transformer 10 when the lamp is ignited and the voltage drop across the ballast 4 increases. When the lamp is ignited, the voltage across the primary 23 of the voltage control transformer 22 induces voltage in the secondary coil 24 thereof.

As soon as the lamp is ignited, the voltage across lead 6 and supply line 2 between the ballast 4 and lamp 8 becomes lamp voltage and not line voltage because the lamp now operates under the lamp operating circuit through ballast 4, which conducts current when the lamp is ignited. Also, since voltage is now developed across the control transformer 22, which is in opposition to the line voltage, the voltage to the ignition transformer is reduced below the lamp operating voltage value. For example, the voltage now delivered to the ignition transformer is about 30 or more volts below lamp operating voltages and far below any voltage that might cause sporadic arcing across the spark gap.

While the invention is described in connection with the specific system illustrated, modifications thereof are contemplated within the scope of the appended claims.

What is claimed is:

1. An operating and ignition system for high pressure arc lamps, comprising an arc lamp containing spaced electrodes and an ionizable atmosphere, leads connected to the electrodes, a ballast means in at least one of the leads in series with the lamp, a pulse type ignition circuit comprising an ignition transformer and a radio frequency transformer each having primary and secondary windings, conductors connecting the terminals of the secondary winding of the ignition transformer and the primary winding of the radio frequency transformer, a spark gap connected across said conductors, a capacitor in one of said conductors, the secondary winding of the radio frequency transformer being connected in one of the leads in series with the lamp, a voltage control means comprising a transformer having primary and secondary windings, the voltage control transformer primary winding being connected across terminals of the ballast means, a conductor means electrically connecting a terminal of the voltage control transformer secondary winding to one of said leads at a location between the ballast and the lamp, the other terminal of the voltage control secondary winding being connected to a terminal of the ignition transformer primary winding, the other terminal of the ignition transformer primary winding being electrically connected to the other of said leads, and a by-pass capacitor connected across said input leads between the ballast and lamp.

2. An operating and ignition system for high pressure arc lamps, comprising an arc lamp containing spaced electrodes and an ionizable atmosphere, leads connected to said electrodes, ballast means in at least one of the leads in series with the lamp, pulse type ignition means connected in one of the leads in series with the lamp, means for energizing the ignition means, one conductor to the energizing means connected to one of the leads, another conductor to the energizing means connected to the another of said leads at a location between the ballast and lamp, a transformer comprising primary and secondary windings, the primary winding being connected across terminals of the ballast, the secondary winding being connected in series in said other lead to the energizing means, and a by-pass capacitor connected across said input leads between the ballast and lamp.

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