Dec. 18, 1934. W. UYTERHOEVEN ET AL 1,984,503

CIRCUIT

Filed April 20, 1934

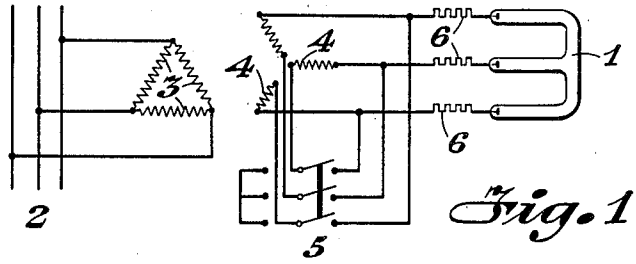


Fig. 1

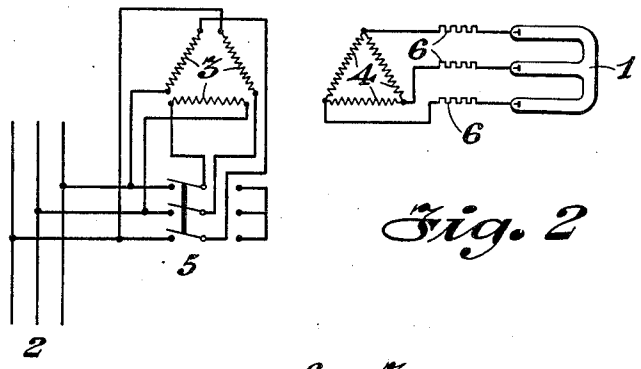


Fig. 2

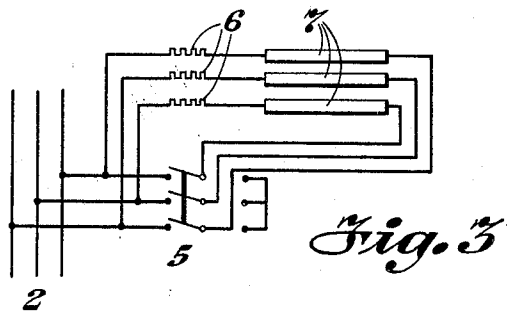


Fig. 3

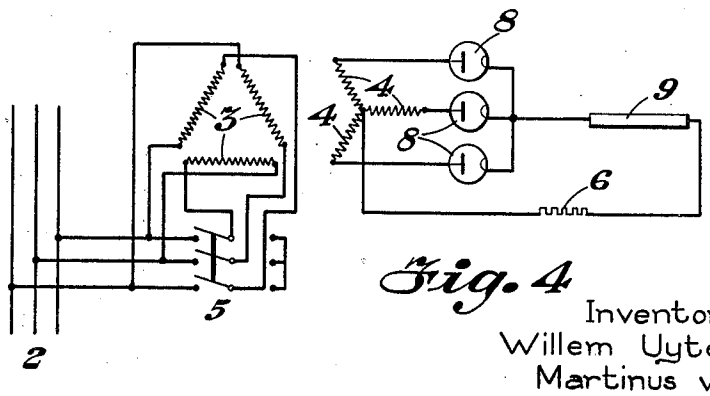


Fig. 4

Inventors:
Willem Uyterhoeven,
Martinus van Dam,
by Harry E. Dunham
Their Attorney.

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1,984,503

CIRCUIT

Willem Uyterhoeven and Martinus van Dam, Eindhoven, Netherlands, assignors to General Electric Company, a corporation of New York

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4 Claims. (Cl. 176—124)

The invention relates to a circuit which contains one or more gas-filled discharge tubes which are energized by a 3-phase alternating-current source. In this connection, gas filling does not only mean a filling consisting of one or more gases but also a filling consisting of one or more vapors or of a mixture of gas and vapor.

According to the invention, such an arrangement is provided with means for decreasing the voltage impressed on each discharge tube, after the discharge has been ignited; this is accomplished by changing a star connection into a delta connection, or vice versa, of the current source which supplies current to a transformer used in this arrangement. The operating voltage of such discharge tubes is considerably smaller than the ignition voltage. This voltage difference is absorbed as a rule by a series-connected resistance or self-inductance. The use of resistances has the disadvantage that a rather large quantity of power is consumed while the application of self-inductances has the disadvantage that the power factor becomes small. These disadvantages are avoided by the invention in an extremely simple manner. According to the invention, a simple change from a star connection to a delta connection, or vice versa, is used to decrease the voltage impressed on the tubes, after the discharge has been started; the voltage is decreased thereby without losses.

The invention can be realized in different ways. If the arrangement contains three separate discharge tubes, then it is possible to connect them in delta when the ignition takes place, connecting them in star during the regular operation. The changeover can also be accomplished at the current source or at a transformer placed between the current source and the discharge tubes. If the arrangement is energized, for instance, by a 3-phase generator, then it is possible to connect the phases of this generator in star during the ignition and in delta after the ignition. If a 3-phase transformer is utilized, the primary winding can be changed from delta into star or the secondary winding from star into delta connection.

The invention is of particular importance for arrangements with one or several discharge tubes which contain the vapor of a metal that is hard to vaporize such as sodium, lithium, magnesium, zinc, thallium, rubidium. At the beginning of the operation of these tubes, the pressure of this metal vapor is very low. As a rule, it takes quite a time for the discharge tubes to heat up to such an extent that the metal vapor has the pressure for normal operation. This so-called heating time can be shortened considerably by not changing the circuit from star to delta, or vice versa, until a certain time after the arrangement has been placed in operation. As a result, the tubes will be overloaded greatly at first whereby they will rapidly assume the required high temperature.

The invention will be readily understood from an inspection of the accompanying drawing and a perusal of the following detailed description thereof. In the drawing,

Fig. 1 is a schematic view of one embodiment of the invention,

Fig. 2 is a similar view of another embodiment of the invention,

Fig. 3 is a similar view of another embodiment of the invention, and

Fig. 4 is a similar view of another embodiment of the invention.

Like numbers denote like parts in all the figures.

The circuit according to Fig. 1 has a discharge tube 1 which serves for the emission of light and which has three legs which are connected together at one end, while in the other ends of the legs an electrode has been arranged which consists, for instance, of an incandescent cathode, that is, an electrode having high electron emission characteristics. Such an electrode consists of a metal filament, such as a tungsten filament, having another filament, such as a nickel filament, wrapped around it and a coating of electron emitting material, such as barium oxide applied to said filaments. The discharge tube contains a filling of gas such as neon at a low pressure and a metal vapor, such as sodium vapor.

A discharge tube which has a positive column discharge during operation is connected to a 3-phase network 2 through a 3-phase transformer. The coils 3 of the primary winding of this transformer are connected in delta, while the coils 4 of the secondary winding of this transformer can be connected in star and in delta with the aid of the star-delta switch 5. If the switch is placed in the left-hand position, the phases will be connected in star, while they will be connected in delta when the switch is thrown over into the right-hand position. Between each coil 4 and the leg of the discharge tube 1 to which this coil is connected, a small stabilizing resistance 6 is provided.

When the discharge tube is placed in operation, the switch 5 is at first thrown into the left-hand position so that the phases 4 are connect-

ed in star and so that high voltages are impressed on the different discharge paths. After the discharge in tube 1 has started, the switch 5 is thrown into the right-hand position whereby the phases 4 are connected in delta so that a considerably lower voltage is supplied to the discharge tube 1.

The circuit according to Fig. 2 differs from that in Fig. 1 in that the coils 4 of the secondary transformer winding are permanently connected in delta, while the coils 3 of the primary transformer winding are connected to the switch 5 in such a way that they can be connected either in delta or in star. When the circuit according to Fig. 2 is placed in operation, the coils 3 are connected in delta in order to ignite the discharge tube, while the connection is changed to star after the ignition has taken place.

The circuit according to Fig. 3 contains three separate discharge tubes 7 which are directly energized by the network 2. These tubes are connected in delta by means of the switch 5 (the switch is in the left-hand position) during the ignition, while for normal operaton they are connected in star (the switch is in the right-hand position).

In the circuit according to Fig. 4, a 3-phase transformer is provided as in the circuit according to Fig. 2; the connection of the primary winding of this transformer can be changed from star into delta and vice versa. The three star-connected phases of the secondary winding are connected to the anodes of the rectifier tubes 8. The cathodes of these discharge tubes are all connected to the anode of the discharge tube 9 which is to be supplied with direct current, while the cathode of this tube is connected to the star point of the secondary-transformer winding through the series impedance 6.

It is evident that the arrangement according to the invention can also have a number of discharge tubes in which case the voltage connected to the tubes can be decreased with the aid of one switching operation. The invention is of particular importance in connection with gaseous electric discharge lamps.

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

1. The combination of a three phase alternating current source, a gaseous electric discharge device comprising a container, thermionic electrodes sealed therein and a gaseous atmosphere therein and means to connect said electrodes to said source in star during the starting period and in delta during the operating period of said device.

2. The combination of a three phase alternating current source, a gaseous electric discharge device comprising a container, thermionic electrodes sealed therein and a gaseous atmosphere therein, a three phase transformer, and means to connect the primary of said transformer in star during the starting period and in delta during the operating period of said device.

3. The combination of a three phase alternating current source, a gaseous electric discharge device comprising a container, thermionic electrodes sealed therein and a gaseous atmosphere therein, a three phase transformer, and means to connect the secondary of said transformer in star during the starting period and in delta during the operating period of said device.

4. The combination of a three phase alternating current source, a plurality of gaseous electric discharge devices, each of said devices comprising a container, thermionic electrodes sealed therein, and a gaseous atmosphere therein comprising a difficultly vaporizable material and means to connect said electrodes to said source in delta during the starting period and in star during the operating period of said devices.

WILLEM UYTERHOEVEN.
MARTINUS VAN DAM.