

Oct. 9, 1934.

L. R. CULVER

1,975,770

CONTROL SYSTEM FOR GAS DISCHARGE TUBES

Filed Jan. 28, 1932

Fig 1.

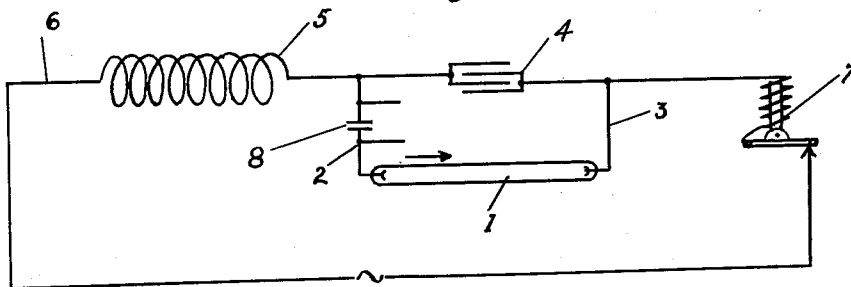


Fig 2.

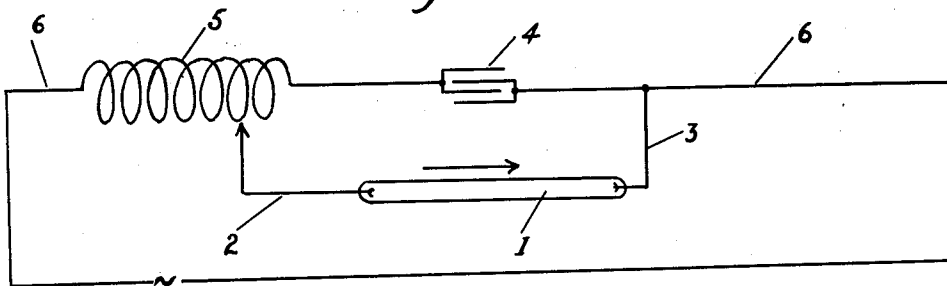
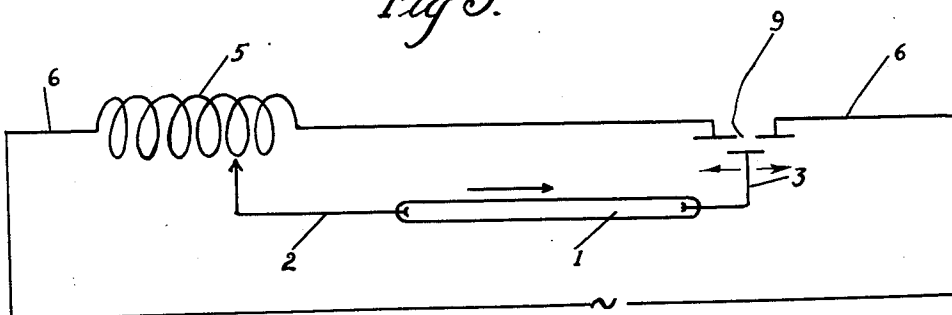


Fig 3.



Inventor,
Laurence R. Culver,
By Arthur H. Ewald,
Attorney.

UNITED STATES PATENT OFFICE

1,975,770

CONTROL SYSTEM FOR GAS DISCHARGE TUBES

Laurence R. Culver, Cincinnati, Ohio

Application January 28, 1932, Serial No. 589,351

9 Claims. (Cl. 250—36)

My invention relates to means for controlling the current in a gaseous discharge tube.

The principal object of the present invention is to provide in combination with a gaseous discharge tube, means for controlling the current therein so as to maintain consistent and uniform performance of said tube.

A further object of the present invention is the generation of high frequency currents.

Further objects of my invention will appear from the following detailed description thereof.

In the drawing:

Figure 1 is a diagram of my invention.

Figure 2 is a modification of the circuit connection shown in Figure 1.

Figure 3 is a further modification of the circuit.

The numeral 1 indicates a tube of the gas discharge type, such as are used in neon signs for instance. The tube 1 is connected by means of wires 2 and 3 in parallel with a condenser 4. The condenser reactance 4 is in series with a coil reactance 5 in a circuit 6 which is designed to be supplied with current from a suitable commercial a. c. source. The tube 1 while in parallel with the condenser reactance 4 is in series with the coil reactance 5. A relay or circuit breaker 7 may be included in the circuit 6.

In Figure 2 the circuits above described are modified to the extent that the conductor 2 of the tube is connected at an intermediate tap of the coil reactance 5.

In Figure 3 the tube 1 is in series and paralld with mixed portions of a variable condenser 9 and coil 5. The condenser and coil reactances in the circuits shown and described should be substantially equal at the frequency of the power supply.

The impedance of the discharge tube 1 being high prior to break down, single phase series resonance is set up in the circuit as shown, and the high voltage of resonance across the condenser, Figure 1, or mixed portions of coil and condenser, Figure 3, is used to cause initial ionization in the tube, whereupon, the impedance of the ionized gas being low, the condition of resonance is destroyed to be set up again, however, upon any interruption of the ionic current. This interrelation between the impedance of the tube and the opposed equal series reactances in the circuit 6 serves effectively to control the ionic current in the tube, such current having a component of like frequency with the current in circuit 6 and of constant r. m. s. value.

As an interruption of the tube current causes

the circuit to revert to single phase series resonance, destructively high voltages may appear across the reactances and the current from the source become excessive. For this reason I prefer to forestall such conditions by the insertion of the circuit breaker 7 which is designed to open the main line circuit when the current reaches a predetermined maximum r. m. s. value. Similar protection might be had, of course, though probably at greater expense, by a voltage operated relay in parallel with either the coil or the condenser.

It is a characteristic of gas discharge tubes, that the impedance of the same does not remain constant and this will result in distortion of the ionic current from the sine form of the source of voltage. Such distortion will also invariably be the case if the coil 5 is iron cored. The tube current is therefore rich in harmonics and may include sustained oscillations of a frequency dictated by the constants of the circuit. These high frequency currents may be usefully employed in radiation or in another circuit by the introduction of a mutual reactance 8, such as the condenser shown or a transformer in the conductor 2. Where such high frequency currents are an object of the device, the connection of the conductor 2 to an intermediate tap of the coil 5, as shown in Figure 2, is useful for altering the circuit constants and thus controlling the generated frequencies.

The circuit connected as shown in Figure 2 does not employ the full voltage across the coil for ionization, but only that portion thereof up to the intermediate tap. This connection, while it is of course, so adjusted as not to interfere with ionization, gives protection where desired to the tube against high frequency currents by the inductance thus placed in series with it and the condenser.

I have found that the circuit as connected in Figure 2 serves better to control distortion and generated high frequencies and is, therefore, normally preferable to the circuit as shown in Figure 1. For instance in a typical example: The supply for circuit 6 was 120 volts, 60 cycle A. C., and the reactances of about 8000 ohms each; the ionic current should then theoretically have been $120 \div 8000$ amperes or 15 m. a. Actually, however, such current was approximately 200 m. a., the excess being due to serious distortion and the generated high frequencies. When the circuit was changed to that shown in Figure 2, however, the ionic current was reduced to 18 m. a. practically the theoretical value.

In the above description and discussion of my invention it should be understood that the principle involved applies only when the coil and condenser reactances are equal at the line or impressed frequency of the supply current, but is not necessarily limited to the operation of gas discharge tubes, as it will give commercially acceptable results in extreme examples of non-linear conduction. For example, a hot cathode gas-filled rectifier-bulb and load may be substituted for the discharge tube with a substantially constant output under varying conditions of load.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A control system for gas discharge tubes, comprising in combination with a source of alternating potential, a series resonant circuit tuned to the frequency of said source, and a gas discharge tube connected across a part only of said series circuit.

2. A control system for gas discharge tubes, comprising in combination with a source of alternating potential, a series resonant circuit containing a pair of equal but opposed reactances in series in said circuit whereby said circuit is tuned to the frequency of said source, and a gas discharge tube connected across one only of said reactances.

3. A control system for gas discharge tubes, comprising in combination with a source of alternating potential, a series resonant circuit containing equal inductive and capacitive reactances in series in said circuit, whereby said circuit is tuned to the frequency of said source, and a gas discharge tube connected across mixed portions of said reactances.

4. A control system for gas discharge tubes, comprising in combination with a source of alternating potential, a series resonant circuit containing equal inductive and capacitive reactances in series in said circuit, whereby said circuit is tuned to the frequency of said source, and a gas

discharge tube connected across said capacitive reactance and a portion of said inductive reactance.

5. A control system of the type set forth, comprising in combination with a source of alternating potential, a series resonant circuit containing equal inductive and capacitive reactances in series in said circuit, whereby said circuit is tuned to the frequency of said source, and a gas filled rectifier bulb connected across said capacitive reactance and a portion of said inductive reactance.

6. A control system for discharge tubes, comprising in combination with a source of alternating potential, a series resonant circuit tuned to the frequency of said source, a gas discharge tube connected across a part only of said series circuit, and a circuit breaker arranged to open the circuit upon interruption of the tube current.

7. A control system for gas discharge tubes, comprising in combination with a source of alternating potential, a series resonant circuit containing a pair of equal but opposed reactances in series in said circuit whereby said circuit is tuned to the frequency of said source, a gas discharge tube connected across one of said reactances, and a circuit breaker to open said circuit upon interruption of the tube current.

8. Means for generating high frequency currents, comprising in combination with a source of low frequency alternating potential, a series resonant circuit tuned to the frequency of said source, and a gas discharge tube connected across a part only of said series circuit.

9. Means for generating high frequency currents, comprising in combination with a source of low frequency alternating potential, a series resonant circuit containing inductive and capacitive reactances in series in said circuit, whereby said circuit is tuned to the frequency of said source, and a gas discharge tube connected across mixed portions of said reactances.

LAURENCE R. CULVER.