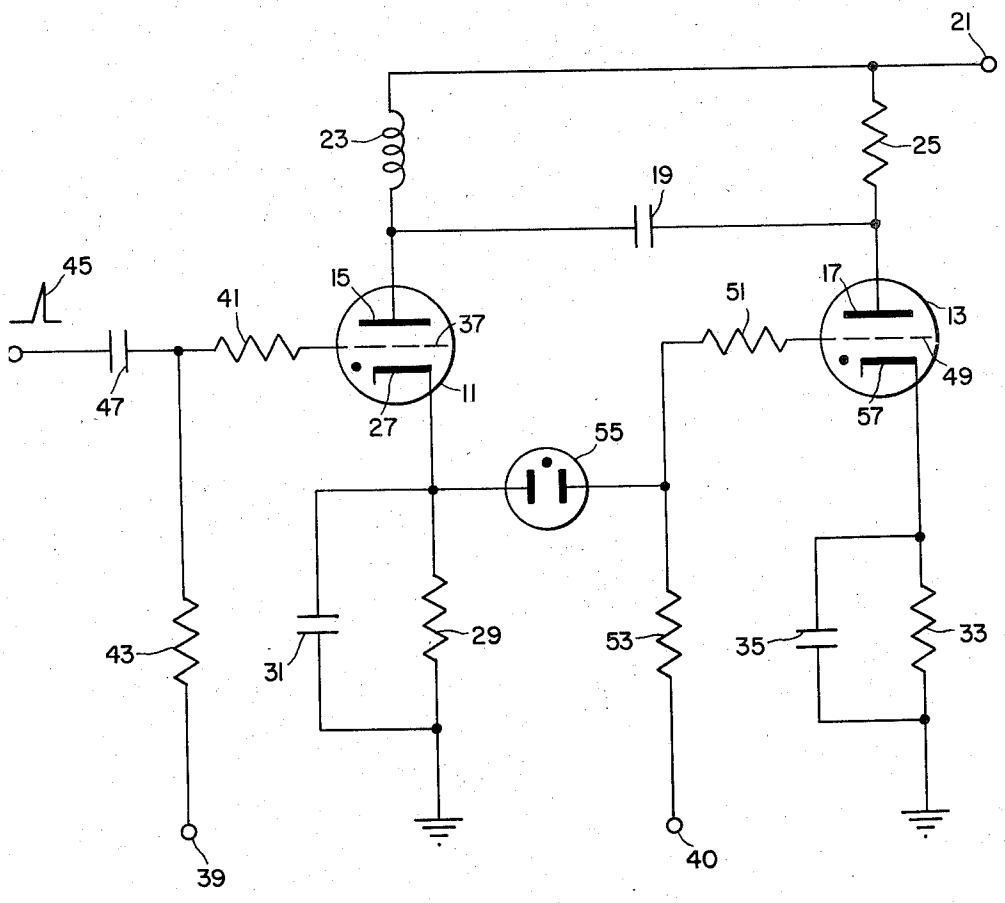
Feb. 17, 1959 R. L. GRAY 2,874,333

THYRATRON PULSER FOR INDUCTIVE LOADS

Filed Oct. 17, 1957



INVENTOR.
ROBERT L. GRAY

BY Thomas A. Herbert

AGENT

United States Patent Office 2,874,333 Patented Feb. 17, 1959

2,874,333

THYRATRON PULSER FOR INDUCTIVE LOADS

Robert L. Gray, Broomall, Pa., assignor to Burroughs Corporation, Detroit, Mich., a corporation of Michigan

Application October 17, 1957, Serial No. 690,828

2 Claims. (Cl. 315—163)

This invenion relates to electronic driving circuit arrangements and more particularly to such circuit arrangements which are suitable for driving electrical load devices of an inductive characteristic with a large current at rapid rates.

It is often desirable to drive an inductive load at a rapid rate in accordance with a series of signal pulses. This is especially true in fields where a stepping switch is required to be sequenced at a high rate. Here the current to supply the inductance must be relatively high and at the same time, if operation is to be as rapid, perhaps, as 300 steps per second, the current wave shape must be comparatively square to prevent holding over of the stepping switch from one operation to the next. The same type of circuit is equally advantageous in many other fields where high speed operation of an inductive load is required in conjunction with a relatively high current. Inductive loads of the type mentioned above, in order to be driven at a high rate, must be supplied with a comparatively large current. This type of current can be supplied most economically by gas-filled tubes. In using the gas-filled tube, it is necessary to arrange a circuit in such a manner that the tube can be cut off in a short space of time so that the inductive load does not draw current from the switching means.

It is an object of my invention to provide a simple and reliable device for generating current pulses for an inductive load upon initiation by a fast pulse rate triggering circuit.

It is another object of my invention to provide a device of the aforementioned character having an adjustable output pulse time limited only in that it be longer than the trigger pulse time.

It is a still further object of my invention to provide an improved cut off characteristic of a gas tube oscillator.

It is still another object of my invention to provide an improved current driver with the aforementioned provisions and having an efficient operating characteristic.

It is also an object of this invention to improve thyratron current drivers in respect to power consumption by providing a circuit which has a standby condition in which neither thyratron is conducting.

The foregoing objects are achieved, in accordance with the present invention, by utilizing two thyratrons in parallel across a B+ supply voltage with a capacitive coupling between the plates. Each of the tubes is normally subjected to a negative bias. The negative bias source for one of the tubes is overcome by a trigger pulse; while the negative bias on the second tube is overcome by the voltage drop across the cathode resistance of the first mentioned tube which is transferred to the grid of the second tube through a neon bulb when the voltage across the aforementioned cathode resistor reaches a point sufficiently high to excite the bulb. This causes firing of the second tube and the ensuing low plate voltage is transferred to the plate of the first tube through the coupling capacitor, turning off the first tube. Subsequently, discharge of the coupling capacitor coupled with the kickback from the inductive load reduces the plate voltage of the second tube to a point below the sustaining voltage thereby extinguishing that tube and leaving it as well as the first mentioned tube cut off and in the control of the negative biasing potential.

A more detailed description of the invention follows in conjunction with the accompanying drawing.

Referring to the figure there is shown a first and a second gas-filled tube 11 and 13, the plate 15 of the first tube 11 is coupled to the plate 17 of the second tube 13 through a capacitor 19. The plate 15 of the first tube 11 is connected to a supply of positive potential (B+) 21 through an inductive load 23 while the plate 17 of the second tube 13 is connected to the B+ supply 21 through a current limiting resistor 25. The cathode 27 of the first tube 11 is returned to ground through a cathode biasing circuit including a resistor 29 and a capacitor 31 in parallel. Likewise, the cathode 57 of the second tube 13 is returned to ground through a cathode bias circuit including a resistor 33 and a capacitor 35. The grid 37 of the first tube 11 is connected to a source of negative biasing potential 39 through an input resistor 41 and a grid return resistor 43. The grid 37 of the first tube 11 is also connected to a source of trigger pulses 45 through the aforementioned input resistance 41 and an input capacitor 47. The grid 49 of the second tube 13 is connected to a source of negative biasing potential 40 through an input resistance 51 and a grid return resistor 53. The biasing potential 40 is chosen such that it is less than the sustaining voltage of a neon bulb 55, but is sufficient to excite the neon bulb 55 when added to the voltage drop across the cathode resistor 29 only while the first tube 11 is conducting. The junction of the resistances 51 and 53 is connected to one side of the neon bulb 55, the other side of the neon bulb 55 is connected to the cathode 27 of the first tube 11.

In the operation of the circuit, at standby neither tube is conducting since both are under control of the negative bias potential. On receiving a trigger pulse at the grid 37 of the first tube 11 through the input capacitor 47 and the input resistor 41, the negative biasing potential 39 is overcome and the first tube 11 commences to conduct through the cathode biasing network including the resistor 29 and the capacitor 31, the first tube 11 and the inductive load 23 to the B+ supply 21. The voltage drop in the cathode resistor 29 caused by the cathode current of the first tube 11 is applied to the neon bulb 55. When the cathode current of the tube 11 reaches a sufficient value, the voltage drop across the cathode resistor 29 in conjunction with the negative voltage of the biasing supply 39 causes the neon bulb 55 to fire. Firing of the neon bulb 55 provides a direct current path to ground from the negative bias supply 39 through the resistor 53, the neon bulb 55, and the resistor 59. The voltage drop across the resistor 53 due to this current is applied to the grid 49 of the tube 13 as a positive voltage. When the positive voltage drop across the resistor 53 becomes approximately equal to the biasing potential 40 applied thereto, the second tube 13 commences to conduct through the cathode biasing network including the resistor 33 and the capacitor 35, the second tube 13, and a current limiting resistor 25 through the B+ supply 21. The decreased plate voltage of the second tube 13 is transferred to the plate 15 of the first tube 11 through the capacitor 19 thereby extinguishing the first tube 11. When the first tube 11 is extinguished, the voltage drop across the cathode resistor 29 is diminished to zero. Since the value of the negative biasing potential 39 has been chosen such that it alone is below the sustaining voltage of the neon bulb 55, the neon bulb

55 is extinguished and the negative bias 39 is again applied to the second tube 13 through the resistors 51 and 53. This bias, however, has no effect at this time, while the second tube 13 is still conducting, since the second tube 13 is a gas-filled tube.

The capacitor 19 and the resistor 25, in conjunction with the inductance 23 form a ringing circuit and the energy stored therein, is applied to the plate 17 of the second tube 13. When the circuit reverses the energy the resultant reverse flow of current is applied at the plate 17 of the second tube 13 and thereby tends to cut that tube off.

The time for this reverse application of voltage is determined by the choice of the resistor 25 and the capacitor 19 as well as the inductance 23. When the first tube 11 is cut off, the ringing caused by the capacitor 19 and the inductance 23 causes the plate 17 of the second tube 13 to first go positive, thereby charging the capacitor 35 in the cathode circuit of the second tube 13. The reverse ringing causes the voltage on the plate 17 of the tube 13 to decrease but the capacitor 35 in the cathode circuit remains charged for a short period of time since it has a relatively long time constant. The combined drop of the plate voltage of the second tube 13 and its high cathode voltage causes the tube to cut off. This cut off occurs at a time when the plate voltage minus the cathode voltage is less than the ionization voltage of the tube. At this point, both the first tube 11 and the second tube 13 as well as the neon bulb 55 are in an extinguished state and the energy being dissipated to zero.

What is claimed is:

1. A current driver comprising a first and a second gas-filled electron discharge tube, each having an anode, a cathode and a control grid, a source of unidirectional operating potential, a load inductance in circuit with said first gas-filled electron discharge device and said source of unidirectional potential, said second gas-filled electron discharge device being in circuit with said source of unidirectional potential, a coupling capacitor connected between the anodes of said first and second tubes, a neon bulb connected from the grid of said second tube to the cathode of said first tube, a bias resistor connected between the cathode of said first tube and a point of reference potential, bias potential means connected to the grids of each of said first and second tubes, and means for connecting the grid of said first gas-filled tube to a source of trigger pulses.

2. A current driver comprising a first and a second thyratron each having an anode, a cathode and a grid, the anode of said first thyratron being coupled to the anode of said second thyratron, bias potential means connected to the grid of each said thyratron, a cathode bias resistor in the cathode circuit of said first thyratron, a source of positive trigger pulses connected to said first thyratron, a neon bulb connected between the cathode of said first thyratron and the grid of said second thyratron, a ringing circuit coupled to the anode of said second thyratron, and a source of unidirectional potential operatively connected to said thyratrons.

References Cited in the file of this patent

UNITED STATES PATENTS

2,593,375	Williams et al.	Apr. 15, 1952
2,616,627	Holden	Nov. 4, 1952
2,646,925	Bevis	July 28, 1953
2,685,683	Holden et al.	Aug. 3, 1954