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BISTABLE MULTIVIBRATOR

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Fig. 1.

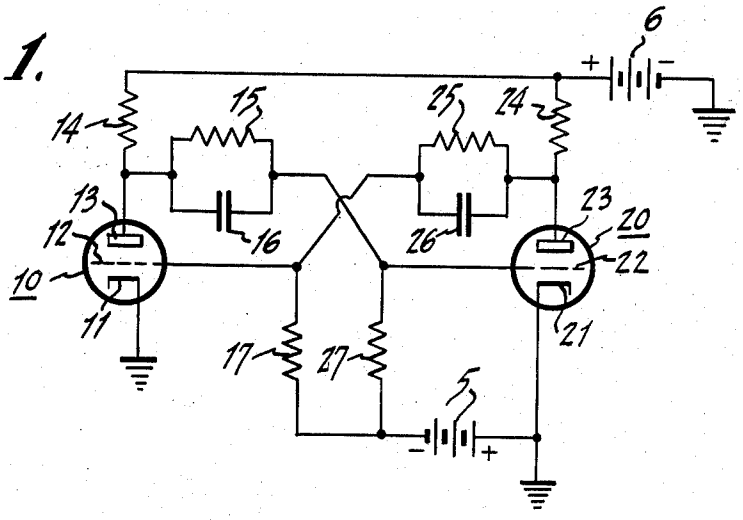
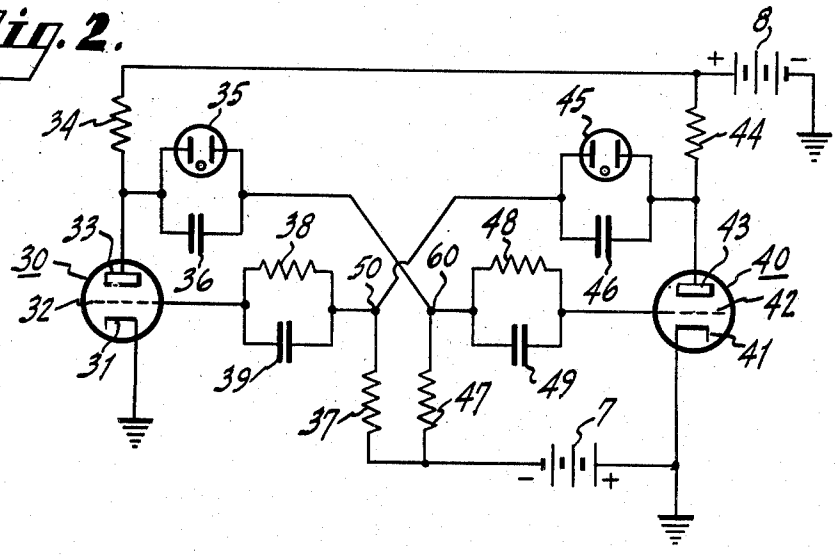


Fig. 2.



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BISTABLE MULTIVIBRATOR

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The invention relates to multivibrators, and particularly to the anode-to-grid coupling circuit in bistable multivibrators.

In the usual bistable multivibrator, the anode of one electron discharge tube is coupled to the control grid of a second electron discharge tube by a resistor that is shunted by a capacitor. The anode of the second tube is coupled to the control grid of the first tube by a second resistor that is also shunted by a capacitor. Such couplings for bistable multivibrators are well known in the art. When the anodes and grids are coupled in this manner, one of the two electron discharge tubes will conduct and the other will be cut off. To switch the two tubes, a control signal or trigger pulse is applied to the multivibrator. When switched, the multivibrator will remain in the new condition until switched again by the application of another control signal.

In order for the prior art bistable multivibrators to function properly it is necessary that corresponding component parts be closely matched, and that all component parts have narrow tolerances. Such narrow tolerances and close matching of the component parts make the prior art multivibrator circuit difficult and relatively expensive to construct.

An object of this invention is to provide a coupling circuit for bistable multivibrators that allows wider tolerances between the matched component parts, and wider tolerances of accuracy for all the component parts of the multivibrator.

In the invention, a gaseous discharge tube is interposed in series with the coupling resistor in the anode-to-grid coupling circuit. The gaseous discharge tube may be shunted by a capacitor. Thus, the gaseous discharge tube provides a constant voltage drop for all values of current, and the resistor limits the grid current. The invention is illustrated in the attached drawings, in which:

Fig. 1 is a typical circuit for a bistable multivibrator having the conventional coupling circuit; and

Fig. 2 is the circuit for a bistable multivibrator having a coupling circuit according to the invention.

A typical conventional circuit for a bistable multivibrator is shown in Fig. 1. Two evacuated electron discharge tubes **10** and **20** are shown with cathodes **11** and **21**, control electrodes or grids **12** and **22**, and anodes **13** and **33** respectively.

As used hereinafter, the term "electron discharge tube" is construed to include any electrode structure whether contained by itself or with some other electrode structure within an evacuated envelope.

The anode **13** of the tube **10** is connected to the control grid **22** of the tube **20** by the resistor **15** connected in parallel with the capacitor **16**. The anode **23** of the tube **20** is connected to the control grid **12** of the tube **10** by the resistor **25** connected in parallel with the capacitor **26**. The two cathodes **11** and **21** are connected to a point of reference potential, such as ground. The control grid **12** of the tube **10** is also connected to the negative terminal of a source of direct current (D.-C.) potential **5** by the resistor **17**. Likewise, the control grid **22** of the tube **20** is connected to the same negative terminal of D.-C. potential **5** by the resistor **27**. A source of direct current (D.-C.) potential **6** supplies positive potential to the anodes **13** and **23** through the resistors **14** and **24** repectively.

In the circuit shown in Fig. 1, all the component parts must have narrow tolerances in order for the circuit to function properly. For example, to attain the desired voltage drops across the resistors **17**, **25** and **24**, or across the resistors **27**, **15** and **14**, it is necessary for these resistors to have narrow tolerances. Likewise, corresponding parts in the multivibrator circuit, for example the resistors **17** and **27**, must be closely matched with each other so that the two parts of the multivibrator balance each other in operation.

In order to eliminate the necessity for narrow tolerances and close matching of the component parts, a gaseous discharge tube is interposed in the coupling circuit between the anode of each tube and the control grid of the other tube. In Fig. 2, two gaseous discharge tubes **35** and **45** are shown connected in a bistable multivibrator circuit in accordance with the invention. The electron discharge tubes **30** and **40** have the cathodes **31** and **41** connected to a point of reference potential, such as ground. The anodes **33** and **43** are connected to the positive terminal of a source of direct current (D.-C.) potential **8** through the anode resistors **34** and **44** respectively. The anode **43** of the tube **40** is connected to the control grid **32** of the tube **30** through the gaseous discharge tube **45** and the resistor **38** which are joined at the junction **50**. A capacitor **46** is connected in parallel with the gaseous discharge tube **45**, and a capacitor **39** is connected in parallel with the resistor **38**. Similarly, the anode **33** of the tube **30** is connected to the control grid **42** of the tube **40** through the gaseous discharge tube **35** and the resistor **48** which are joined at the junction **60**. A capacitor **36** is connected in parallel with the gaseous discharge tube **35**, and a capacitor **49** is connected in parallel with the resistor **48**. A source of direct current (D.-C.) potential **7** has its negative terminal connected through the resistors **37** and **47** to the junction points **50** and **60** respectively.

With the gaseous discharge tubes **35** and **45** inserted in the multivibrator circuit as shown in Fig. 2, the two functions usually required of the resistors **15** and **25** in Fig. 1 have been divided. Normally, the resistors **15** and **25** serve as both voltage dropping resistors and as grid-current limiting resistors. However, in Fig. 2, the gaseous discharge tubes **35** and **45** give the necessary voltage drop, and the resistors **38** and **48** limit the grid current to the specified value. The capacitors **36** and **46** that are connected in parallel with the gaseous discharge tubes **35** and **45** give the circuit the quick response desired, but may be omitted. With such a circuit, the voltage drop across the gaseous discharge tubes **35** and **45** is constant for practically all values of current, and the voltages at the junction points **50** and **60** change with the voltages at the anodes **43** and **33** volt for volt. Thus, the values and tolerances of the other resistors are far less critical and dependent on each other.

The electron discharge tubes **30** and **40** may be any conventional triodes, such as type 6211 which contains both tubes in one envelope. The gaseous discharge tubes **35** and **45** may be any conventional dual-electrode gaseous discharge tube, such as type NE–2 neon glow discharge device. Typical values of the other component parts, with the tolerances allowed in this invention, are as follows:

7	150 v.±10 v.
8	80 v.±5 v.
34,44	10,000 ohms ±5%.
36,46	.01 mfd. ±20%.
37,47	1.5 megohms ±20%.
38,48	100,000 ohms ±20%.
39,49	10 mmfd. ±10%.

The invention claimed is:

1. In a multivibrator, the combination of a pair of electron discharge tubes, and a pair of paths cross-coupling said tubes so that when one of said tubes is conducting the other of said tubes is cut off, each of said cross-coupling paths comprising a gaseous discharge tube and a resistor in series therewith, a capacitor connected in parallel with said gaseous discharge tube, and a capacitor connected in parallel with said resistor.

2. In a multivibrator, the combination of a first electron discharge tube, a second electron discharge tube, each of said tubes having an anode, a cathode, and a control grid, and means connecting said tubes so that when one of said tubes is conducting the other of said tubes is cut off, said connecting means comprising a first gaseous discharge tube connected to the anode of said first electron tube, a first resistor serially connected between said first gaseous discharge tube and the control grid of said second electron tube, a capacitor connected in parallel with said first gaseous discharge tube, and a capacitor connected in parallel with said first resistor, and further comprising a second gaseous discharge tube connected to the anode of said second electron tube, a second resistor serially connected between said second gaseous discharge tube and the control grid of said first electron tube, a capacitor connected in parallel with said second gaseous discharge tube, and a capacitor connected in parallel with said second resistor.

3. A bistable multivibrator comprising a first source of direct current potential, a second source of direct current potential, a first electron discharge tube, a second electron discharge tube, each of said tubes having an anode, a cathode, and a control grid, means connecting said anodes to the positive terminal of said first source of direct current potential, a first gaseous discharge tube, a first resistor, means connecting the anode of said first electron tube serially through said first gaseous discharge tube and said first resistor to the control grid of said second electron tube, a capacitor connected in parallel with said first gaseous discharge tube, a capacitor connected in parallel with said first resistor, a second gaseous discharge tube, a second resistor, means connecting the anode of said second electron tube serially through said second gaseous discharge tube and said second resistor to the control grid of said first electron tube, a capacitor connected in parallel with said second gaseous discharge tube, a capacitor connected in parallel with said second resistor, means connecting the negative terminal of said second source of direct current potential to each junction of said gaseous discharge tubes and said resistors, a point of reference potential, and means connecting said cathodes to said point of reference potential.

4. A bistable multivibrator comprising a first source of direct current potential, a second source of direct current potential, a point of reference potential, a first triode vacuum tube, a second triode vacuum tube, a first gaseous discharge tube, a second gaseous discharge tube, means connecting one electrode of said first gaseous discharge tube to the anode of said first triode, a first resistor having two terminals, means connecting one terminal of said first resistor to the control grid of said second triode, means joining the other terminal of said first resistor to the other electrode of said first gaseous discharge tube, means connecting a capacitor in parallel with said first resistor, means connecting a capacitor in parallel with said first gaseous discharge tube, means connecting one electrode of said second gaseous discharge tube to the anode of said second triode, a second resistor having two terminals, means connecting one terminal of said second resistor to the control grid of said first triode, means joining the other terminal of said second resistor to the other electrode of said second gaseous discharge tube, means connecting a capacitor in parallel with said second resistor, means connecting a capacitor in parallel with said second gaseous discharge tube, means connecting the negative terminal of said second source of direct current potential to said joining means between said first resistor and said first gaseous discharge tube and to said joining means between said second resistor and said second gaseous discharge tube, means connecting the positive terminal of said first source of direct current potential to the anode of said first triode and to the anode of said second triode, and means connecting the cathode of said first triode and the cathode of said second triode to said point of reference potential.

5. In a bistable multivibrator circuit having two triode vacuum tubes, a regenerative circuit comprising the series arrangement of a gaseous discharge tube and a resistor between the anode of each triode and the control grid of the other triode, a capacitor connected in parallel with said gaseous discharge tube, and a capacitor connected in parallel with said resistor.

6. A bistable multivibrator comprising a first source of direct current potential, a second source of direct current potential, a first and a second electron discharge tube, each of said tubes having an anode, a cathode, and a control grid, means connecting said anodes to the positive terminal of said first source of direct current potential, a first gaseous discharge tube, a first resistor, means connecting the anode of said first electron tube serially through said first gaseous discharge tube and said first resistor to the control grid of said second electron tube, a capacitor connected in parallel with said first resistor, a second gaseous discharge tube, a second resistor, means connecting the anode of said second electron tube serially through said second gaseous discharge tube and said second resistor to the control grid of said first electron tube, a capacitor connected in parallel with said second resistor, means connecting the negative terminal of said second source of direct current potential to each junction of said gas tubes and said resistors, a point of reference potential, and means connecting said cathodes to said point of reference potential.

7. In a bistable multivibrator circuit having two triode vacuum tubes, a pair of circuits each comprising the series arrangement of a gaseous discharge tube and a resistor between the anode of each triode and the control grid of the other triode, and a capacitor connected in parallel with said resistor.

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